



CIZIK SCHOOL OF NURSING

SIMULATION LAB

Issue for Construction

July 2, 2018

PROJECT MANUAL

FKP Project No. 45017.0000
CIP No. 1601

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SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 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. 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.

1.2 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. This Section identifies each Alternate by number, and describes the basic changes to be incorporated into the Work, only when that Alternate is made a part of the Work by specific provisions in the Owner-Contractor Agreement.
1. Ascertain all changes made in the Work if an Alternate is accepted. Claims for extras resulting from the changes caused by the Alternates will not be allowed.
 2. Indicate in the appropriate space on the Bid Form the cost associated with each Alternate Bid and whether the cost is to be added to or deducted from the Base Bid.
- C. Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the project. Indicate, on the bid form, the additive or deductive cost, as appropriate, for each Alternate listed below.
- D. Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.
- E. Specification Sections referenced in the "Schedule of Alternates" contain requirements for materials and methods necessary to achieve the Work described under each Alternate.
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 mentioned as part of the Alternate.

1.3 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: If accepted by the Owner, state the amount to be added to the base bid for removal of the cork panel finish and replace with back painted glass. See Section 088113 Decorative Glazing.
- B. Alternate No. 2: If accepted by the Owner, state the amount to be deducted from the base bid to salvage the existing and grid for reuse in Corridor **4H04 and 4H05**
- C. Alternate No. 3: If accepted by the Owner, state the amount to be deducted from the base bid for deleting of the hot water system including the water heater, valves and piping and install a Insta-Hot system at all new sinks. See plumbing specs.
- D. Alternate No. 4: If accepted by the Owner, state the amount to be deducted from the base bid for deleting the acoustical ceiling panels in Corridor **4H04 and 4H05**

- E. Alternate No. **5**: If accepted by the Owner, state the amount to be added to the base bid for providing new projection screens in all rooms that currently show the existing screens being relocated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 23 00

SECTION 02 41 19 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 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, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials become Contractor's property; remove from Project site.

1.3 PRE-DEMOLITION MEETING

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

1.4 SUBMITTALS, GENERAL

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Engineering Survey: Submit engineering survey of condition of building.

- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 - D. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - E. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
 - F. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
 - G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.
- 1.6 CLOSEOUT SUBMITTALS
- A. Inventory: Submit a list of items that have been removed and salvaged.
 - B. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- 1.7 QUALITY ASSURANCE
- A. Demolition Firm Qualifications: Employ an experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
 - B. Professional Engineer Qualifications: Comply with Division 01 Section "Quality Requirements."
 - 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.
- 1.8 PROJECT CONDITIONS
- A. Owner will occupy portions of building immediately adjacent to remodeling procedures area. Conduct remodeling procedures so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
 - B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
 - C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Before selective demolition, Owner will remove the following items:
 - a. As indicated on the drawings.

- D. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- F. Storage or sale of removed items or materials on-site will not be permitted.
- G. 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.

1.9 COORDINATION

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

PART 2 - PRODUCTS

A. PERFORMANCE REQUIREMENTS

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

2.2 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- E. 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.
- F. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

- G. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- H. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- I. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
 - 1. Comply with requirements specified in Division 01 Section "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
- C. Utility Requirements: Refer to Facilities Services Subgroup Divisions for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 SELECTIVE DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 5 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. 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.
- D. Removed and Salvaged Items: Comply with the following:
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.
- E. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- F. 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.
- 3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
- A. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- 3.5 PATCHING AND REPAIRS
- A. Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 01 Section "Cutting and Patching."

3.6 DISPOSAL OF DEMOLISHED MATERIALS

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

3.7 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 02 41 19

SECTION 03 01 33 – CONCRETE SEALER

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each type of product. Include material descriptions, physical properties, test data, and mixing, preparation, and application instructions.
- E. Samples for Verification: Cured samples for each exposed product and for each color and texture specified.
 - 1. Include Samples of each required type, color, and texture of sealer material in the form of cementitious tiles at least 8 inches (200 mm) long by 8 inches (200 mm) wide.
- F. Qualification Data: For manufacturers.
- G. Product Test Reports: For each sealer, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Each sealer manufacturer shall employ factory-trained technical representatives who are available for consultation and Project-site inspection and assistance at no additional cost.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.

1.4 PROJECT CONDITIONS

- A. Environmental and Substrate Conditions: Do not proceed with application of sealer (except with written recommendation of manufacturer) under any of the following conditions:
 - 1. Ambient temperature is less than 40 deg F (4 deg C).
 - 2. Substrate surfaces have cured for less than one month.
 - 3. Temperatures below 40 deg F (4 deg C) are predicted for a period of 24 hours.
 - 4. Earlier than 24 hours after surfaces became wet.
 - 5. Surface temperature of substrate is less than 40 deg F (4 deg C).

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain each color, grade, finish, type, and variety of product from single source with resources to provide products of consistent quality in appearance and physical properties.

- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

2.2 CONCRETE SEALER

- A. Transparent, VOC compliant, water-based curing and dustproofing compound recommended by manufacturer to be compatible with and able to develop bond to substrate under conditions of service and application, as demonstrated by sealer manufacturer based on testing and field experience.
- B. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of <manufacturer's name>, <model or design number>. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, <products of other manufacturers will also be acceptable>< products of the following manufacturers will also be acceptable >.
- C. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of the following listed manufacturers. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.
 1. BASF; MasterKure CC 200 WB.
 2. Dayton Superior; Cure & Seal 1315 J22WB..
 3. The Euclid Chemical Company; Diamond Clear.
 4. L&M Construction Chemicals, Inc.; Dress & Seal WB 25
 5. <Insert name of manufacturer and product>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 1. Verify that concrete has cured and aged for minimum time period recommended by sealer manufacturer.
 2. Verify that substrate is visibly dry and free of moisture.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for sealer application.
- B. Mask off adjoining surfaces not receiving sealer to prevent spillage or overspray affecting other construction.
- C. Close off drains and other penetrations to prevent spillage and migration of sealer fluids.

3.3 APPLICATION

- A. Apply sealer to concrete surface in a continuous film using hand or power sprayer.
- B. Apply uniformly without puddles.
- C. Ensure each previous coat is thoroughly dry before applying subsequent coats of sealer.

3.4 PROTECTION AND CLEANING

- A. Cure sealer according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
- B. Protect sealer from damage during remainder of construction period.

- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 03 01 33

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SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. 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 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.
 - 2. For fire-retardant treatments specified to be High-Temperature (HT) type 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.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- E. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.2 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. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Powder-actuated fasteners.
 - 5. Expansion anchors.
 - 6. Metal framing anchors.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 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.

1.5 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. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. 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.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- C. 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 FIRE-RETARDANT-TREATED MATERIALS

- A. 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. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898.
 - a. Use Exterior type for exterior locations and for wood cants, nailers, curbs, blocking, plywood, and similar members in connection with roofing, waterproofing, flashing, and parapet construction, and other locations indicated.
 - 3. 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.

4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- E. Application: Treat all miscellaneous carpentry unless otherwise indicated.
 1. Concealed blocking.
 2. Plywood backing panels.

2.3 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. Furring.
 4. Utility shelving.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent maximum moisture content and any of the following species:
 1. Mixed southern pine; SPIB.
 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
- C. For utility shelving, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Mixed southern pine, No. 1 grade; SPIB.
 3. Hem-fir or hem-fir (north), Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
 4. Spruce-pine-fir (south) or spruce-pine-fir, Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine, No. 2 grade; SPIB.
 2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods, No. 2 Common grade; NELMA.
 5. Northern species, No. 2 Common grade; NLGA.
 6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.
- E. 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.
- F. 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.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PANEL PRODUCTS

- A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch and 3/4-inch nominal thickness.
 - 1. Plywood 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."

2.6 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. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 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.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives 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."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit 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.

- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. 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.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- 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. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- I. 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.

3.2 PANEL PRODUCT INSTALLATION

- A. Wood Structural Panels: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above-referenced guide.

3.3 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. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.4 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 Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.5 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 06 41 16 – PLASTIC LAMINATE-CLAD WOOD CABINETRY

PART 1 - GENERAL

1.1 SUBMITTALS, GENERAL

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories.
- 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 for plumbing fixtures faucets soap dispensers and other items installed in cabinetry.
 - 4. Indicate, in elevations and details, the kinds of materials, dimensions, thickness or gauges, of all parts, reinforcement, where applicable, and provision for concealed piping, including venting of piping spaces and items of hardware and accessories.
- C. Samples for Initial Selection:
 - 1. Plastic Laminates: Six inch square sample of each color specified for Project.
 - 2. PVC Edge Material: Twelve inch long sample of each finish and thickness required for Project.
 - 3. Thermoset decorative panels.
 - 4. Solid-surfacing materials.
- D. Samples for Verification:
 - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 2. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish, with edge banding on one edge.
 - 3. Solid-surfacing materials, 6 inches square.
 - 4. 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.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

- B. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standard, Latest Edition, for grades of interior architectural woodwork, construction, finishes and other requirements.
 - 1. Provide AWI Quality Certification Program Labels and Certificates indicating that the woodwork, including installation, complies with requirements of grades specified.
 - a. Upon award of Contract, register the Work under this section with the AWI Quality Certification Program.
- C. Preinstallation 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. Do not deliver cabinetry until painting and similar operations that could damage cabinetry have been completed in installation areas. If cabinetry must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinetry 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 cabinetry 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 cabinetry by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinetry can be supported and installed as indicated.
- B. Coordinate with Mechanical, Electrical, and Plumbing work for installation and connection of all utilities and fixtures, fittings, and trim installed in or on cabinetry.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide materials that comply with requirements of AWI's quality standard for each type of cabinetry and quality grade specified, unless otherwise indicated.
 - 1. Wood Moisture Content: 8 to 13 percent.

2.2 WOOD MATERIALS

- A. Comply with the following:
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. High Performance Moisture Resistant Particleboard Core: 47 lb. density, and balanced construction with moisture content not to exceed 7 percent. Provide particleboard that meets or exceeds the requirements for its type and classification under Commercial Standard CS-236-66, Federal Specifications LLL-B-800A, and ASTM D 1037.

5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - a. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.3 FINISH MATERIALS

- A. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by cabinetry quality standard.
 1. The notes and schedules in the Documents establish manufacturer and model/design required for the Project. Provide the products listed unless Architect approves products of other manufacturer specifically for this Project.
 2. Laminate Cladding for Exposed Surfaces:
 - a. Horizontal Surfaces: Grade HGS.
 - b. Postformed Surfaces: Grade HGP.
 - c. Vertical Surfaces: Grade VGS.
 - d. Pattern Direction: As indicated on the drawings.
 3. Materials for Semiexposed Surfaces:
 - a. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - b. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
 - c. Drawer Bottoms: Thermoset decorative panels.
- B. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 1. The notes and schedules in the Documents establish manufacturer and model/design required for the Project. Provide the products listed unless Architect approves products of other manufacturer specifically for this Project.
 2. To establish standards of manufacture, performance, and appearance, Drawings and Specifications are based on products of the following listed manufacturers. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.
 - a. Aristech Surfaces (Avonite).
 - b. DuPont.
 - c. Formica Corporation.
 - d. Wilsonart International, Inc.
- C. Edging: Solid, high impact, purified, color-thru, acid resistant, PVC edging machine-applied with waterproof hot melt adhesives, automatically trimmed for uniform appearance. Color to match exterior laminate.
 1. Provide cabinet body edged with one millimeter thick PVC.
 2. Provide drawers and doors edged with three millimeter thick PVC, edges machine profiled to 1/8 inch radius, buffed and corners radiused.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Division 08 sections.
- 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. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
 - 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
 - 6. For computer keyboard shelves, provide Grade 1HD-100.
 - 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.
 - E. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
 - F. Door Locks: BHMA A156.11, E07121.
 - G. Drawer Locks: BHMA A156.11, E07041.
 - H. Door and Drawer Silencers: BHMA A156.16, L03011.
 - I. Adjustable Shelf Supports: BHMA A156.11, B04013. Injection molded friction fit into cabinet end panels and vertical dividers, adjustable with dual 5 mm diameter pins on 32 mm centers and locking tabs to accommodate 3/4 inch (19 mm) or 1 inch (25 mm) thick shelves.
 - 1. Product: Hardware Concepts 5030.
 - J. Hanging Rod: 1-inch- diameter steel tube or rod, chrome finished.
 - K. Countertop Support Brackets: Epoxy powder coated, 0.1119 inch (3.04 mm) thick steel with integral cleat mount opening and wire management opening.
 - 1. Product: A&M Hardware; Work Station Bracket.
 - a. Color: As selected by the Architect. .
 - L. Grommets: Where indicated, provide plastic grommets with separate, removable cap with cable slot.
 - 1. Product: Doug Mockett and Co., Inc. "SG" Series, color selected by Architect.
- 2.5 MISCELLANEOUS MATERIALS
- A. Provide softwood lumber furring, blocking, shims, and hanging strips for installing cabinetry items unless these items are previously installed and concealed within other construction before cabinetry installation.
 - 1. Provide kiln softwood lumber dried to less than 15 percent moisture content.
 - B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
 - C. Adhesive for Bonding PVC Edge Material: Hot-melt adhesive.
- 2.6 PLASTIC LAMINATE-CLAD CABINETS
- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 - B. Grade: Premium.
 - C. AWI Type of Cabinet Construction: Flush overlay unless otherwise indicated.
 - D. Cabinet, Door, and Drawer Front Interface Style: Reveal overlay.
 - 1. Reveal Dimension: As indicated on the drawings. .

- E. Cabinet Body Construction: Construct each cabinet body of polyester laminated high performance moisture resistant particleboard as a complete rigid case completely enclosed with sides, backs, bottoms, tops, headers, rails, and soffits fastened together forming a rigid integral unit.
1. Sub-Base: provide a separate and continuous ladder type construction of 3/4 inch unfinished veneer core plywood with Type II adhesive. Particleboard base is not acceptable.
 2. Cabinet Top and Bottom (Wall and Base Cabinets):
 - a. Provide 3/4 inch thick cabinet bottoms of white polyester laminated high performance moisture resistant particleboard on the interior side.
 - 1) Provide 1 inch thick bottom panels for wall cabinets and library stacks.
 - 2) Provide phenolic backer sheet on concealed side.
 - b. Provide solid sub-top, 3/4 inches thick, for all base cabinets.
 - 1) Provide phenolic backer sheet on concealed side.
 - c. Laminate exposed edges with color-through purified P.V.C.; color to match exterior high pressure plastic laminate.
 3. Cabinet Ends: Provide 3/4 inch thick cabinet ends of white polyester laminated high performance moisture resistant particleboard on the interior side.
 - a. Finish interior of cabinet ends on units with glass doors or without doors with high pressure plastic laminate to match exterior plastic laminate color.
 - b. Holes drilled for adjustable shelves on 32 mm centers.
 - c. Laminate exposed edges with 1 mm thick, color through purified P.V.C., color to match exterior high pressure plastic laminate.
 4. Fixed and Adjustable Shelves:
 - a. Thickness: 3/4 inch thick standard shelving up to 36 inches wide. 1 inch thick shelving 36 inches wide to a maximum of 48 inches wide.
 - b. Provide shelves in semi-exposed cabinets behind solid doors with white colored polyester laminate top and bottom.
 - c. Provide shelves in open cabinets or cabinets with glass doors with high pressure laminate same as cabinet exterior.
 - d. Laminate exposed edges with 1 mm thick, color through purified P.V.C., color to match exterior high pressure plastic laminate.
 - 1) For adjustable shelves laminate all four edges.
 5. Cabinet Backs: 3/8 inch thick white colored prefinished hardboard for use on all cabinets.
 - a. Exposed interior backs in cabinets without doors or with glass doors: Provide 3/4 inch high performance moisture resistant particleboard faced with high pressure plastic laminate same as cabinet exterior.
 - b. Concealed side of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
 6. Doors and Drawer Fronts: Provide 13/16 inch thick plastic laminated high performance moisture resistant particleboard for drawer fronts and all hinged and sliding doors. Provide white colored heavy gauge balancing sheet on interior face. Maintain a maximum 1/8 inch reveal between pairs of doors, and drawer front or between multiple drawer fronts within the cabinet body. Color to match exterior laminate.
 - a. Where indicated provide 13/16 inch thick plastic laminate clad stile and rail doors glazed with 1/4 inch float glass. Glaze with extruded vinyl glazing bead.
 - b. Where indicated provide all glass sliding doors of 1/4 inch thick tempered glass with ground and polished edges.
 - c. Provide 3 mm thick, solid, high-impact, purified, color-through, acid resistant, PVC edging machine-applied with hot melt adhesives. Machine profile all door and drawer edges and outside corners, exposed to view when doors and drawers are closed, to a 1/8 inch radius.
 7. Drawers: Provide drawer fronts applied to separate drawer body sub-front. High Pressure plastic laminate on the exterior face and heavy gauge white colored backing sheet on interior face. Total thickness: 13/16 inch.
 - a. Drawer sides and backs: 1/2 inch thick white colored polyester laminated fiberboard; sub-front, same except 5/8 inch thick.

- b. Provide dadoed drawer side panels to receive front and back panels.
 - c. Provide 1/4 inch thick white colored polyester laminate fiberboard drawer bottoms. Provide reinforcement as required with intermediate spreaders.
 - d. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
8. Vertical and Horizontal Dividers: White colored polyester laminated plywood 3/4 inch thick, secured in cabinet with molded plastic clips. Laminate exposed edges with 1 mm thick, color through purified P.V.C., color to match exterior high pressure plastic laminate.
9. Door/Drawer Spreaders: Provide minimum 3/4 inch x 6 inch x full width white finished cabinet body spreaders immediately behind all door/drawer and multiple drawer horizontal joints to maintain exact body dimensions, and close off reveal. Provide white flat edge PVC.
10. Table Frames and Rails: Provide table frames and rails as structurally independent units consisting of front and back rails, approximately 4 inches high, but not exceeding 4-1/2 inches in height, with cross member reinforcing and stiffeners. Provide units suitable for free standing installation on table legs, between adjacent cabinets, or between cabinet and wall. Provide table frames and rails that provide support at front and back of countertop. Where indicated, provide legs to support the table frames at freestanding tables or open-end assemblies as needed.
- a. Where indicated provide drawers in table frame consisting of front and back rails as described in "Drawers" subparagraph above.
 - 1) Provide drawer hardware as specified in "Cabinet Hardware and Accessories" Article.
 - 2) Unless otherwise indicated, independent drawers fastened to underside of countertop are not acceptable.

2.7 FABRICATION, GENERAL

- A. Cabinetry Grade: Unless otherwise indicated, provide cabinetry complying with referenced AWI quality standard in "Plastic Laminate-Clad Cabinets" Article of this section.
 - 1. Fabricate cabinetry completely from plywood panel products. No particleboard will be permitted.
- 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. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times cabinetry fabrication will be complete.
 - 2. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - a. Seal edges of openings in countertops with a coat of varnish.
 - 3. 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.
 - 4. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.
- D. Properly temper all material under controlled humidity and temperature conditions prior to gluing.
- E. Provide cases that are square, plumb, and true.

- F. Provide removable back panels and closure panels for plumbing access at all sink units.
- G. Provide wall cabinets with a minimum clear inside depth of at least 11-3/4 inches (275 mm) unless indicated otherwise.
- H. Prepare end panels and vertical dividers, except sink base units, to receive adjustable shelf support hardware by way of continuous line borings, 5 mm in diameter, on 32mm centers.
 - 1. Mount door hinges, drawer slides, and pull-out shelves on line borings to maintain vertical alignment of components and provide for future relocation of doors, drawers, and pull-out shelves.

2.8 FABRICATION OF COUNTERTOPS

- A. Provide countertops of types indicated on the Drawings.
 - 1. Provide countertops in longest practicable lengths to minimize field joints with seams at same location for tops and curbs.
 - 2. Note locations of field joints on shop drawings.
 - 3. Provide countertops, backsplashes, and backsplash returns of dimensions indicated and which fit on top of base cabinet assemblies as follows.
 - a. Cabinet ends: Not more than 1 inch (25 mm).
 - b. Cabinet front: 1-1/2 inches (38 mm) plus or minus 1/4 inch (6 mm).
 - 4. Exposed fasteners for countertops are not permitted.
- B. Plastic Laminate-Clad Countertop, designated Type 1 Top: Fabricate from minimum 3/4 inch moisture resistant medium density fiberboard with a 24 hour thickness swell factor of 4.5 percent of less over 1/2 inch thick hardwood frame. Provide a finished countertop that is 1-1/2 inches thick.
 - 1. At countertops over open spaces install a full sheet of 1/2 inch moisture resistant medium density fiberboard with a 24 hour thickness swell factor of 4.5 percent of less beneath the 3/4 inch material to provide a smooth, uninterrupted surface and cover the expose surface with a phenolic resin sheet or laminated plastic backing sheet.
 - 2. At countertops containing sinks, provide moisture resistant medium density fiberboard with a 24 hour thickness swell factor of 4.5 percent of less.
 - 3. Fabricate countertops 12 feet or less in length in one piece. Use field joints only when length of countertop exceeds 12 feet.
 - 4. Form field joints with concealed flush-bolted construction that provides a hairline joint, sealed with an acceptable waterproof compound.
 - 5. Edge Treatment: Three millimeter thick PVC, Solid, high impact, purified, color-thru, acid resistant, PVC edging machine-applied with hot melt adhesives. Machine profile all edges and outside corners exposed to view to a 1/8 inch radius. Color to match surface laminate.
 - 6. Edge Treatment: Same as laminate cladding on horizontal surfaces.
 - 7. Cover underside of core panel with a phenolic resin sheet or laminated plastic backing sheet.
- C. Solid Surface Material, designated Type 7 Top: Fabricate from 3/4 inch) thick solid surfacing material over full 1/2 inch thick moisture resistant medium density fiberboard with a 24 hour thickness swell factor of 4.5 percent of less; manufacturer and color of solid surface material as indicated in the Code To Finishes on the Drawings.
 - 1. Fabricate countertops 12 feet or less in length from a single piece of material. Use field joints only when length of countertop exceeds 12 feet.
 - 2. Provide curbs, return curbs, or box curbs in shop and as indicated on Drawings.
 - 3. Install integral sink bowls in countertops in shop.
 - 4. Form holes and other openings in countertops for plumbing fixtures and accessories in shop.
 - 5. Provide tops with a continuous 1-1/2 inch deep finished front edge unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinetry to average prevailing humidity conditions in installation areas.
- B. Examine shop-fabricated work for completion and complete work as required, including removal of packing materials.

3.2 INSTALLATION

- A. Install cabinetry complying with referenced AWI quality standard in "Plastic Laminate-Clad Cabinets" Article of this section.
- B. Install cabinetry 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.
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 1. Minimize width and number of scribes used consistent with need and in no case exceeding 6 inches (150 mm) in width.
- D. 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. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 1. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 2. Caulk space between backsplash and wall with sealant specified in Division 07 section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinetry, where possible, to eliminate functional and visual defects; where not possible to repair, replace cabinetry. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware; ensure smooth operation without binding or interference with adjacent components.
- C. Clean cabinetry on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 41 16

SECTION 06 61 16- SOLID SURFACING FABRICATIONS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each type of product signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.
- E. Samples for Initial Selection: Submit in the form of manufacturer's color charts consisting of actual pieces or sections of pieces showing full range of colors and patterns available for each type of solid surfacing material indicated.
- F. Samples for Verification: Submit three sets not less than 12 by 12 inches (300 by 300 mm) in size, of color, grade, and finish of each type of solid surfacing material required. Include the full range of exposed color and texture to be expected in the completed work. Architect's review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
- G. Submit cutting and setting drawings showing sizes, dimensions, sections, and profiles of solid surfacing material units, the arrangement, and provisions for jointing and other necessary details for reception of other work. Submit drawings for the fabrication and installation of countertops with integral bowls. Indicate dimensions, size, and location of cutouts, and relation to plumbing work.
- H. Warranty: Sample of manufacturer's warranty.

1.2 QUALITY ASSURANCE

- A. Fabricator Qualifications: Provide Work of this section fabricated and installed by a fabricator who has been accredited by the manufacturer of the solid surfacing materials. Engage a fabricator who is skilled in the knowledge and ability required to provide work in accordance with the manufacturer's "Fabrication and Installation Manual," has a minimum of five years fabrication experience and has completed a minimum of five projects of similar scope and complexity to the fabrication and installation Work of this Project.
- B. Source Quality Control: Obtain and provide materials from a single manufacturer with not less than five years of successful experience in supplying principal materials. Provide secondary and alternate materials only as recommended by the manufacturer of the primary materials.
- C. Wherever possible, check dimensions of supporting structure at the Project Site by accurate field measurements before final submittal of shop drawings and fabrication of solid surfacing fabrications. Where necessary, proceed without field measurements and coordinate installation tolerances to ensure proper fit of solid surfacing fabrications.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Protect solid surfacing material from damage during loading, shipment, delivery, and storage. Use non-staining materials for blocking and packing. Stack and block solid surfacing material units at the Site in accordance with fabricator's recommendations.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperature of 50 to 95 degrees F (10 to 35 degrees C) for 48 hours before, during and for minimum 7 days after installation.

1.5 WARRANTY

- A. Warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's standard form in which manufacturer agrees to repair or replace solid surfacing components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Cracking, splitting, or delamination.
 - b. Deterioration of finishes beyond normal wear.
 - 2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Solid Surfacing Material: Composed of a homogeneous mixture of thermoset polymer, cast with an acrylic or polyester resin into a hard, durable, polished unit.
 - 1. "Corian" by DuPont.
 - a. Refer to drawings for color
- B. Solid Surface Material: For use on Countertops, Custom Benches and Thresholds.

2.2 MATERIAL

- A. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.

2.3 FABRICATION

- A. Performed by a fabricator, accredited by the manufacturer, in accordance with manufacture's recommendations and reference manuals.
- B. Shop fabricate components to greatest extent practicable to size and shapes indicated, in accordance with approved shop drawings.
- C. Comply with the manufacturer's recommendations for the use of specific types of stationary equipment and stationary tools. Perform site fabrication and finishing processes in accordance with the manufacturer's recommendations.
- D. Form seams between components, unless otherwise indicated, using solid surfacing material manufacturer's standard structural adhesive. Color-coordinate adhesive to match solid surfacing material color and result in a seamless appearance. Seams along the long side of any areas of less than 36 inches (900 mm) across are not permitted.
- E. Provide factory cutouts for plumbing fittings as indicated on the drawings and as recommended by the solid surfacing manufacturer.
- F. Cut and finish component edges with clean sharp returns. Rout radii and contours to exact template sizes. Repair or reject defective or inaccurate work.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare substrate plane, plumb and level, secure in place with all fasteners set flush. Shim supporting structure as required to provide an acceptable surface for attaching finish materials.
- B. Install components plane, plumb and level, in accordance with approved shop drawings and product data.
- C. Pre-fit finish material in place. Scribe material as required to provide proper fit with adjacent materials.
- D. Provide additional support for material seams in both horizontal and vertical locations. Provide separation/release paper provided between all supports and seams to prevent direct adhering of finish material to substrate.
- E. Form field joints using manufacturer's recommended adhesive, with inconspicuous joints in finished work.
- F. Prior to installing fabrications, make sure that substrate is clean and dry. Place silicone "dads" on substrate in accordance with manufacturer's recommendations.

3.2 CLEANING AND PROTECTION

- A. At Substantial Completion remove temporary protection and thoroughly clean work. Do not use wire brushes, acids, abrasive cleansers, or solutions which might cause discoloration or abrasion. Clean by scrubbing with a soft cloth using liquid detergents as recommended by the manufacturer and water. Rinse with clear water. Repoint joints where necessary.
- B. Protect installed products and finish surfaces from damage during construction.

END OF SECTION 06 61 16

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SECTION 06 64 23 – RESIN PANELS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Indicate product description, fabrication information, compliance with specified performance requirements.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- F. Samples for Verification:
 - 1. Resin Panel: 12-inch x 12-inch (300mm x 300mm) sample of each color and finish required.
- G. Maintenance Data: Submit manufacturer’s care and maintenance data, including care, repair and cleaning instructions. Include in Project close-out documents.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed projects similar in material, design, and extent to that indicated for this Project.
- B. Surface-Burning Characteristics: Provide panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction.
 - 1. Flame-Spread Rating: 25 or less.
 - 2. Smoke-Developed Rating: 450 or less.
- C. Single-Source Responsibilities: Obtain resin panels from one source from a single manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.
- B. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels indoors in a dry place at the project site.
- C. Remove foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.4 PROJECT CONDITIONS

- A. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.
- B. During installation, and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The notes and schedules in the Documents establish manufacturer and model/design required for the Project. Provide the products as indicated on the drawings unless Architect approves products of other manufacturer specifically for this Project.

2.2 MATERIALS

- A. Resin Panels:
 - 1. Thickness: As indicated on the drawings.
 - 2. Pattern: As indicated on the drawings.
 - 3. Color: As indicated on the drawings.
 - 4. Top Finish: As indicated on the drawings.
 - 5. Bottom Finish: As indicated on the drawings:.

2.3 FABRICATION

- A. Fabricate resin panels to designs, sizes and thicknesses indicated on Drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
- D. Forming: Form products to shapes indicated using the appropriate method in compliance with manufacturer's printed instructions.
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.4 MISCELLANEOUS MATERIALS

- A. Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.
- D. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates for unsuitable conditions where fabrications are to be installed.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects. Follow manufacturer's printed instructions.

3.3 INSTALLATION, GENERAL

- A. Comply with panel manufacturer's Installation Guide.
- B. Install panels plumb, level, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
 - 1. Scribe and cut to fit adjoining Work.
- C. Install with minimum number of joints practical, using full size panels.
- D. Predrill fastener holes in fabrications. Clean fastener holes, removing loose dirt or oil.
- E. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.
- F. Install panels with manufacturer's recommended gap for panel field and corner joints.
- G. Predrill fastener holes in panels with 1/8 inch (3.2 mm) oversize.
- H. For trowel type and application of adhesive, follow adhesive manufacturer's recommendations.
- I. Use products acceptable to panel manufacturer and install system in accordance with panel manufacturer's printed instructions.

3.4 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Repair or replace products that have been installed and are damaged. Clean installed products in accordance with manufacturer's printed instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.
 - 1. Remove all adhesive or excessive sealant from panel face using only products recommended in writing by panel manufacturer.

3.5 PROTECTION

- A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION 06 64 23

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SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 - 1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 - 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
 - 3. Fire-resistance-rated floor assemblies.
 - 4. Fire-resistance-rated roof assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - 1. Penetrations located outside wall cavities.
 - 2. Penetrations located outside fire-resistive shaft enclosures.
 - 3. Penetrations located in construction containing fire-protection-rated openings.
 - 4. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. L-Rated Systems: For penetrations in smoke barriers, provide systems with L-ratings as determined per ASTM E 814 or UL 1479 not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- E. W-Rated Systems: Provide through-penetration firestop systems with Class 1 W-ratings as determined per UL 1479.
- F. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- G. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.2 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.

- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.
 - 1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
- D. Special Requirements:
 - 1. Provide through-penetration firestop systems which comply with IBC 2012, Section 714 for penetrations into or through fire-resistive walls, smoke barrier walls, fire-resistive floor or floor-ceiling assemblies, and fire resistive roof and roof-ceiling assemblies.
 - 2. Provide UL approved steel sleeves at all wall penetrations for fire-protection, plumbing, and HVAC piping to accommodate movement of piping without disrupting the penetration seal. .

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where ITS-listed systems are indicated, they refer to the design numbers listed in ITS's "Directory of Listed Products," "Firestop Systems" Section.

2.2 MANUFACTURERS

- A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of Hilti Construction Chemicals, Inc. Provided compliance with Project requirements, products of the following manufacturers will also be acceptable:
 - 1. 3M Fire Protection Products.
 - 2. Isolatek International.
 - 3. Specified Technologies Inc.

2.3 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - 1. Permanent forming/damming/backing materials, including the following:
 - Slag-/rock-wool-fiber insulation.
 - Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - Fire-rated form board.
 - Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.

4. Collars.
5. Steel sleeves.

2.4 FILL MATERIALS

- A. Provide through-penetration firestop systems containing the types of fill materials required for each specific penetration. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Latex-Based Intumescent Sealant: Acrylic-based, high solids firestop compound; UL Classified or FM Systems Approved and tested to the requirements of ASTM E 814 (UL1479).
 1. Color: Red.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. 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.
- I. Blocks/Plugs: Reusable and ready-to-use, intumescent flexible block based on a two-component polyurethane foam. Where exposed, cover openings with steel reinforcing wire mesh to protect blocks from being easily moved.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Moisture-curing, 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 other surfaces requiring a nonslumping, gun grade sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.5 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. 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 through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by through-penetration firestop systems. Remove masking and temporary covering as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing 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, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems 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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Through-penetration firestop system manufacturer's name.
 6. Installer's name.

3.5 CLEANING AND PROTECTION

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

3.6 PRODUCT SCHEDULE

- A. Firestop Systems for Vertical (Metallic or Plastic) Pipe, Conduit, Tubing, or Cable Penetrations through a Preformed Firestop Device (FS-1): Comply with the following:
1. Acceptable UL-Classified Systems with respective FA 1000, FA 2000, FA 3000 or CAJ 3000 Series Systems equivalent to, but not limited to, the following (by Hilti):
 - a. FA1016, FA1017, FA2053, FA2054, FA2213, CAJ3285.
 - b. CP 680 Cast-in Firestop Device
 - c. CP 680 Cast-in Firestop Device.
 - d. CP 653 Speed Sleeve.
 - e. CFS-DID Drop In Device.
- B. Firestop Systems with No Penetrating Items (FS-2): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ or FA 0000 Series Systems equivalent to, but not limited to, the following (by Hilti): CAJ0055, CAJ0070, FA0012.
 2. Type of Fill Materials: One or more of the following (by Hilti):
 - a. CFS-BL Firestop Block.
 - b. FS-ONE MAX Intumescent Firestop Sealant.
 - c. CFS-S SIL GG Firestop Gun Grade Silicone Sealant.
 - d. CFS-S SIL SL Firestop Self-Leveling Silicone Sealant.
- C. Firestop Systems for Metallic Pipes, Conduit, or Tubing (FS-3): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ, FA, or WL 1000 Series Systems, equivalent to, but not limited to, the following (by Hilti): CAJ1291, CAJ1226, FA1016, FA1028, FA1105, WL1054, and WL1465.
 2. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Acrylic sealant.
 - d. Intumescent sealant or putty.
 - e. Mortar.

- f. Polyurethane firestop foam.
 - g. Preformed firestop device.
- D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing (FS-4): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, FA, or WL 2000 Series Systems, equivalent to, but not limited to, the following (by Hilti): CAJ2109, CAJ2567, FA2053, FA2058, WL2078, and WL2128.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Intumescent putty.
 - c. Intumescent wrap strips.
 - d. Intumescent collar device.
 - e. Latex sealant.
 - f. Preformed firestop device
- E. Firestop Systems for Electrical Cables (FS-5): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, FA, WJ, or WL 3000 Series Systems, equivalent to, but not limited to, the following (by Hilti): CAJ3095, CAJ3285, CAJ3320, FA3034, WJ3200, WL3065, WL3112, WL3335, WL3395, and WL3396.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Latex sealant
 - c. Pillows/bags
 - d. Intumescent putty.
 - e. Preformed firestop device
 - f. Firestop sleeve device.
 - g. Silicone foam.
- F. Firestop Systems for Cable Trays (FS-6): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ or WL 4000 Series Systems equivalent to, but not limited to, the following (by Hilti): CAJ4035, CAJ4077 and WL4011.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Intumescent putty.
 - c. Silicone foam.
 - d. Pillows/bags.
 - e. Foam blocks.
 - f. Firestop mortar.
 - g. Polyurethane firestop foam.
- G. Firestop Systems for Insulated Pipes (FS-7): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, FA, or WL 5000 Series Systems, equivalent to, but not limited to, the following (by Hilti): CAJ5091, FA5016, FA5018, and WL5029.
 - 2. Type of Fill Materials: One or more of the following:
 - Intumescent sealant.
 - Silicone foam.
 - Intumescent wrap strips.
 - Pre-formed intumescent blocks.
 - Latex sealant.
 - Preformed Firestop Device.
- H. Firestop Systems for Miscellaneous Electrical Penetrants (FS-8): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ or FA 6000 Series Systems equivalent to, but not limited to, the following (by Hilti): CAJ6006, CAJ 6017 and FA6002.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Intumescent sealant.
 - b. Latex sealant
 - c. Intumescent putty.

- d. Mortar.
 - e. Silicone sealant.
- I. Firestop Systems for Miscellaneous Mechanical Penetrations (FS-9): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, WJ, or WL 7000 Series Systems equivalent to, but not limited to, the following (by Hilti): CAJ7084, CAJ7154, WJ7109, WJ7112, WJ7124, WL7042, WL7153, WL7155 and WL7156.
 - 2. Type of Fill Materials: One or both of the following:
 - a. Intumescent sealant.
 - b. Latex sealant.
 - c. Mortar.
 - d. Acrylic sealant.
 - e. Silicone sealant.
- J. Firestop Systems for Groupings of Penetrations (FS-10): Comply with the following:
- 1. Acceptable UL-Classified Systems with CAJ, WJ, or WL 8000 Series Systems, equivalent to, but not limited to, the following (by Hilti): CAJ8056, CAJ8143, WJ8007, WL8014, WL8019, and WL8065.
 - 2. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Mortar.
 - c. Intumescent wrap strips.
 - d. Firestop device.
 - e. Intumescent composite sheet.
 - f. Pre-formed intumescent blocks.
- K. Firestop Systems for Membrane Penetrations (FS-11):
- 1. Acceptable UL-Classified Systems with CP617 or CFS-P PA and firestop box insert.
 - 2. Type of Materials: Intumescent putty pads.

END OF SECTION 07 84 13

SECTION 07 84 43 – JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. For the following constructions, provide joint firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly.
 - 1. Safing slot gaps between edge of floor slabs and perimeter curtain walls.
 - 2. Openings between structurally separate sections of wall or floors.
 - 3. Gaps between the top of walls and ceilings or roof assemblies.
 - 4. Expansion joints in walls and floors.

1.2 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings: For each joint firestop system, show each kind of construction condition and relationships to adjoining construction. Include joint firestopping design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each joint firestopping system configuration.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Certificates: Signed by manufacturers of joint firestopping system products certifying that products furnished comply with requirements.
- G. Product Test Reports: From a qualified testing agency indicating joint firestopping system complies with requirements, based on comprehensive testing of current products.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.
 - 1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its joint firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Source Limitations: Obtain joint firestop systems, for each kind of construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide joint firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is one which performs testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Joint firestop systems are identical to those tested per ASTM E 1966 or ANSI/UL 2079. Provide joint firestop system products that bear classification marking of a qualified testing and inspecting agency.
 - a. Provide firestop systems which comply with IBC Section 711 for joints between fire-resistive walls, fire-resistive floor or floor-ceiling assemblies, and fire resistive roof and roof-ceiling assemblies.

D. Special Requirements:

1. Where joints in fire-resistive construction are subject to cyclic movement due to thermal stresses, wind loads, live, and dead loads, provide through penetration firestop systems which have been tested in accordance with ASTM E 1399 test standards.
2. Provide joint firestopping systems with ratings determined per ASTM E 2307:
 - a. F-Rating: not less than the fire resistance rating of the construction they will join.
 - b. Perimeter slab edge fire containment systems indicated on Drawings are necessarily diagrammatic in nature. Provide all necessary components including, but not limited to, joint filler, joint sealant, gypsum board or mineral wool curtainwall member protection, insulation attachments, and other components necessary to comply with the requirements of the submitted tested assembly, or engineering judgement approved by the authority having jurisdiction.
3. Provide joints in smoke barriers with ratings determined per UL 2079:
 - a. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
4. Provide joint firestopping systems at intersections between rated wall assemblies and non-rated horizontal assemblies with ratings determined by ASTM E 2837.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

- A. Coordinate construction and installation of joint firestopping systems to ensure joint firestop systems are installed according to specified requirements.
- B. Do not cover up joint firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 JOINT FIRESTOP SYSTEMS

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

2.2 MANUFACTURER

- A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of Hilti Construction Chemicals, Inc. Provided compliance with Project requirements, products of the following manufacturers will also be acceptable:
 - 1. 3M Fire Protection Products.
 - 2. Isolatek International.
 - 3. Specified Technologies Inc.

2.3 FIRESTOPPING, GENERAL

- A. Compatibility: Provide joint firestop systems that are compatible with one another, with adjacent substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each joint firestop system that are needed to install materials and to comply with "Performance Requirements" Article. Use only components specified by joint firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Fire-rated form board.
 - 2. Substrate primers.
- C. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric self-leveling or gun grade sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Ensure surfaces to receive joint firestop systems are prepared in compliance with written recommendations of firestop system manufacturer and the following requirements:
 - 1. Remove from surfaces of substrates foreign materials that could interfere with adhesion of joint firestop systems. Ensure surfaces are free of dirt, grease, oil, rust, laitance, release agents, water repellents, and other substances that may affect proper adhesion.
- B. Priming: Prime substrates where recommended in writing by joint firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by joint firestop systems. Remove masking and temporary covering as soon as possible without disturbing firestop system's seal with substrates.

3.3 JOINT FIRESTOP SYSTEM INSTALLATION

- A. Install joint firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings to produce installations with ratings matching those established during fire-test-response testing.

- B. Install forming/damming/backing materials and other accessories of types required to support firestop system 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 firestop system materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

3.4 CLEANING AND PROTECTION

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

3.5 PRODUCT SCHEDULE

Joint Type	F-Rating (Hr)	Hilti Basis of Design UL System	
		Joint Width Less than or Equal to 2 inches	Joint Width Greater than 2 inches and less than or Equal to 6 inches
Concrete (Floor to Floor)	1	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	2	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	3	FF-D-1011, FF-D-1026 ¹	FF-D-1011, FF-D-1026
	4	FF-D-1047	FF-D-1125
Concrete (Edge of Floor Slab to Wall)	1	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	2	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	3	FW-D-1011	FW-D-1011, FW-D-1021
	4	FW-D-1047	FW-D-1092
Concrete or Block Wall to Flat Concrete Structure (Top-of-Wall)	1	N/A**	N/A**
	2	HW-D-0097 ¹	HW-D-1009
	3	HW-D-1008 ¹ , HW-D 0268	HW-D-1008
	4	HW-D-1042	HW-D-1103
Concrete or Block Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0098	N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098	HW-D-1037
	3	N/A**	N/A**
	4	HW-D-0294	N/A**
Gypsum Wall to Flat Concrete Structure (Top-of-Wall)	1	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	2	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	3	HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
Gypsum Shaft Wall to Structure	2	HW-D-0342 (FLAT CONCRETE) HW-D-0541, HW-D-0542 (CONCRETE OVER METAL DECK)	N/A**
Gypsum Shaft Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0023	N/A**
	2	BW-S-0023	N/A**
Gypsum Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
	2	BW-S-0001, BW-S-0002, BW-S-0039	N/A**

Gypsum Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D-538*	HWD-1011, HWD-1012, HW-1020
	2	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-292, HW-D-0295, HW-D0538*	HW-D-1011, HW-D-1012, HW-D-1020
	3	HW-D-0292, HW-D-0295	HWD-1011, HWD-1012, HW-1020
	4	HW-D-0292, HW-D-0295	N/A**
Concrete (Wall to Wall)	2	WW-D-0017, WW-D-0082	WW-D-1080, WW-D-1084
	3	WW-D-1011 ¹ , WW-D-0032	WW-D-1011
	4	WW-D-1047	WW-D-1128
Gypsum to Concrete (Wall to Wall)	1	WW-D-0040	N/A**
	2	WW-D-0040	N/A**

END OF SECTION 07 84 43

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. 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.
- E. Samples for Verification: For each type and color of joint sealant required. Install 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.
- F. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- G. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- I. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- J. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.
- K. Warranties: Special warranties specified in this Section.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 329.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
 - 1. Label "Do Not Use" and remove from Project site materials subjected to moisture, contaminants or temperature extremes outside manufacturer's recommended limits.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: 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 ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths vary from the range allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.5 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. .
- B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 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 sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: Provide custom color(s) for exposed elastomeric sealants, to match Architect's samples

2.2 POLYURETHANE ELASTOMERIC SEALANTS

- A. Single-Component Nonsag Urethane Sealant:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 25.
 3. Use Related to Exposure: NT (nontraffic)
 4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 5. Products:
 - a. Sikaflex - 1a; Sika Corporation.
 - b. MasterSeal NP1, Division of BASF Building Systems.
 - c. PR-255; Ohio Sealants, Inc.
 - d. Dynatrol I; Pecora Corporation.
 6. Locations: All sealant joints on interior side of components subject to thermal movement from external heat sources.

2.3 LATEX JOINT-SEALANT

- A. Latex Sealant Standard: Comply with ASTM C 834.
1. Products:
 - a. Chem-Calk 600; Bostik Inc.
 - b. AC-20; Pecora Corporation.
 - c. PSI-701; Polymeric Systems, Inc.
 2. Applications: All non-fire-rated interior locations, exposed and concealed, including all non-fire-rated wall penetrations concealed above finished ceilings, except where elastomeric sealants are indicated or required.

2.4 ACOUSTICAL JOINT-SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
1. 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.
 2. Products:
 - a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
 - b. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.
 - c. CP 506 Smoke and Acoustic Sealant, Hilti Construction Chemicals, Inc.
- B. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
1. Product: BA-98; Pecora Corporation.

2.5 MILDEW-RESISTANT SILICONE SEALANT:

- A. Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 25.
 3. Use Related to Exposure: NT (nontraffic).
 4. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 5. Applications: Sealant joints at perimeter of plumbing fixtures, countertops, and all other interior locations subject to exposure to moisture.
 6. Products:
 - a. 786 Mildew Resistant; Dow Corning.
 - b. Sanitary 1700; GE Silicones.
 - c. 898 Silicone Sanitary Sealant; Pecora Corporation.

2.6 JOINT-SEALANT BACKING

- A. Provide sealant backings of material and type 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, of type recommended by sealant manufacturer and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
- E. Pavement Joint Filler: Closed cell polyethylene foam expansion material, 1/2" thick by depth of concrete, designed with a removable 1/2" strip at top to provide void for sealant installation.
 - 1. Similar to "Closed Cell Control Strip" by Construction Foam Products.

2.7 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 with 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.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.
 3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on 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 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. 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 of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical and Smoke Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. Install sealant backings of type 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.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- F. Install sealants by proven techniques to 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 provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 sealants from surfaces adjacent to joint.
 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 configuration per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint configuration, per Figure 8B in ASTM C 1193, where indicated.
 5. Provide recessed joint configuration, per Figure 8C in ASTM C 1193, of recess depth and at locations indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

- H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
 - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - 2. Apply a bead of silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's printed schedule and covering a bonded area of not less than a 3/8 inch. Hold edge of sealant bead inside of masking tape by 1/4 inch.
 - 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 - 4. Complete installation of horizontal joints before installing vertical joints. Lap vertical joints over horizontal joints. At end of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, to produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant to comply with sealant manufacturer's written instructions.

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 elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants by hand-pull method described below:
 - a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
 - b. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
 - c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
 - 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
 - 4. Inspect tested joints and report on the following:
 - a. 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 type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
 - 5. 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.
 - 6. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

- B. Evaluation of Field-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 sealants 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 the original work.

END OF SECTION 07 92 00

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SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 ACTION SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - 1. Coordinate submittals with other doors, frames, and hardware and use the same "opening number identification" as given on the Drawings and the Door Schedule.
 - 2. Submittals not using the numbering identification system shown on Architect's Drawings and Schedules will be rejected.
- E. Door 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 final Door Hardware Schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.
- B. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C or UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, the neutral pressure plane in furnace shall be established at 40 inches or less above the sill.
- C. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

- B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of the following listed manufacturers. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.
 - 1. Steel Doors and Frames:
 - a. Ceco Door Products; a United Dominion Company.

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

2.3 DOORS

- A. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI 250.8 for level and model and ANSI/SDA A250.4 for physical-endurance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless). 18 Ga., 0.042-inch-
- B. Door Louvers: Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
- C. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.

2.4 FRAMES

- A. Provide steel frames for doors, sidelights that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
- A. Interior Metal Frames; for frame openings up to 48 inches wide: 16 Ga., 0.053-inch- thick steel sheet.
 - 1. For frame openings over 48 inches wide: 14 Ga., 0.067-inch- thick steel sheet.
- B. Door Silencers: Except on frames with smoke or weather seals, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.
- C. Plaster Guards: Provide 0.016-inch- thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.
- D. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.5 FABRICATION

- A. Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Interior Door Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
 - 1. Cold-rolled steel sheet.
- C. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
- D. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
- E. Clearances for Fire-Rated Doors: As required by NFPA 80.
- F. Double-Acting, Door-Edge Profile: Round vertical edges with 2-1/8-inch radius.
- G. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- I. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- J. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier.
 - 1. In addition to typical door and frame hardware, coordinate and factory prepare doors and frames as required for security devices and all other building systems devices.
 - 2. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
 - 3. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.
- K. Frame Construction: Fabricate frames to shape shown.
 - 1. Fabricate frames with mitered or coped and continuously full profile welded corners and seamless face joints, unless otherwise indicated.
 - 2. Provide welded frames with temporary spreader bars.
- L. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- M. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- N. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- thick steel sheet.
 - 1. Locate fixed and removable glazing stops as indicated on Drawings.
- O. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.6 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
 - 2. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
 - 3. Install fire-rated frames according to NFPA 80.
 - 4. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
- C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
 - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.

3.2 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

END OF SECTION 08 11 13

SECTION 08 12 16 –ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of components including hardware, glazing, and glazing stops. Show attachments to other Work.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of manufacturer's standard sizes and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed interior aluminum framing systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing interior aluminum framing systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Source Limitations: Obtain aluminum frames through one source from a single manufacturer with the capacity and resources to provide products of consistent quality in appearance and physical properties.
- D. Product Options: Drawings indicate dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction size. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Sections.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Fire-Rated Door Frames: Frames 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.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver frames palletted, wrapped, or crated to provide protection during transit and job storage.
- B. Inspect frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are approved by Architect; otherwise, remove and replace damaged items as directed.
- C. Store frames at building site under cover and as near as possible to final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior aluminum frames until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; flooring, walls, ceilings, and 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.
- B. Field Measurements: Verify interior aluminum frame dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Raco Interior Products, Inc.
 - 2. Versatrac; a division of A. J. May, Inc.
 - 3. Architectural Components, Incorporated.
 - 4. Dual Lock Partition Systems
 - 5. Framework Manufacturing Co., Inc.
 - 6. Modulex, Inc.
 - 7. Western Integrated Materials, Inc.
 - 8. Wilson Partitions, Inc.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M) alloy 6063-T5 or alloy and temper required to suit structural and finish requirements.
- B. Structural Silicone Sealant: Type recommended by sealant and system manufacturers that complies with ASTM C 1184 requirements, is compatible with system components with which it comes in contact, and is specifically formulated and tested for use as a structural sealant.
 - 1. Color: Clear
 - 2. Tensile Strength: 100 psi (689.5 kPa) minimum.
 - 3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by structural-sealant-glazed systems' design.

2.3 COMPONENTS

- A. Provide interior aluminum frame components that comply with dimensions, profiles, and relationships to adjoining work of components indicated on Drawings.
- B. Door Frames: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick, reinforced for hinges and strikes.
- C. Doors: Manufacturer's standard 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed EPDM gaskets.
 - 2. Provide slow return closer on sliding doors.
- D. Glass Frames: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick, designed for glass thickness indicated.
- E. Ceiling Tracks: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick.

- F. Trim: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick, removable snap-in glass stops and door stops without exposed fasteners.

2.4 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers (Mutes): Manufacturer's standard mohair or vinyl.
- C. Glazing Gaskets: Manufacturer's standard extruded or molded plastic
- D. Glazing: As specified in Division 08.
- E. Hardware: As specified in Division 08.
 - 1. Finish exposed parts to match door finish, unless otherwise indicated.

2.5 FABRICATION

- A. Machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame with concealed screws.
- B. Provide concealed corner reinforcements and alignment clips for precise butt or mitered connections.
- C. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
 - 1. Fabricate frames for glass to allow glass replacement without dismantling frame.
- D. Fabricate all components to allow secure installation without exposed fasteners.
- E. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with polyamide epoxy coating.

2.6 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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.
- C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- D. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals and pretreated with chromate phosphate; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with frame manufacturer's written installation instructions and approved Shop Drawings. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Install frames plumb and square, securely anchored to substrates with fasteners recommended by frame manufacturer.
- C. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
 - 1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
- D. Install partition components in the longest possible lengths; components up to 48 inches (1200 mm) long must be one piece. Fasten to suspended ceiling grid on maximum 48-inch (1200-mm) centers, using sheet metal screws or other fasteners approved by frame manufacturer.
 - 1. Use concealed installation clips to ensure that splices and connections are tightly butted and properly aligned.
 - 2. Secure clips to main structural extrusion components and not to snap-in or trim members.
 - 3. Do not leave screws or other fasteners exposed to view when installation is complete.
- E. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm). Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- F. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.3 CLEANING AND ADJUSTING

- A. Clean exposed frames promptly after installation, using cleaning methods recommended by frame manufacturer.
 - 1. Clean and maintain anodized aluminum according to AAMA 609.
- B. Touch up marred areas so touchup is not visible from a distance of 48 inches (1200 mm). Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

3.4 PROTECTION

- A. Provide protection required to ensure that framing will be without damage or deterioration on Substantial Completion.

END OF SECTION 08 12 16

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each type of door. Include details of core and edge construction, and trim for openings.
- E. 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. Coordinate submittals with other doors, frames, and hardware and use the same "opening number identification" as given on the Drawings and the Door Schedule.
 - a. Submittals not using the numbering identification system shown on Architect's Drawings and Schedules will be rejected.
 - 2. Indicate dimensions and locations of mortises and holes for hardware.
 - 3. Indicate dimensions and locations of cutouts.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire ratings for fire doors.
- F. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 4 by 6 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.
- G. Sample Warranty: For special warranty.
- H. Quality Standard Compliance Certificates.

1.2 QUALITY ASSURANCE

- A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- B. Quality Standard: Comply with the following standards:
 - 1. WDMA I.S.1-A "Architectural Wood Flush Doors" (most recent edition).
 - a. Provide AWI QCP (Quality Certification Program) labels or certificates indicating that doors comply with requirements of grades specified.
- C. 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 UL 10-C or UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, the neutral pressure plane in furnace shall be established at 40 inches or less above the sill.
 - 2. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
 - 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

4. 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.

1.3 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.4 WARRANTY

- A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 1. Warranty shall also include installation required due to repair or replacement of defective doors.
 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION, GENERAL

- A. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
- B. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

2.2 DOOR FACING

- A. Doors for Transparent Finish:
 1. Grade: Premium, with Grade A faces.
 2. Species and Cut: Red oak, plain sliced.
 3. Species and Cut: White oak, rift cut.
 4. Species and Cut: White birch, rotary cut.
 5. Species and Cut: White ash, plain sliced.
 6. Match between Veneer Leaves: Book match.
 7. Assembly of Veneer Leaves on Door Faces: Balance Center balance match.
 8. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 9. 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 10 feet or more.
 10. Stiles: Same species as faces.

2.3 20 MINUTE RATED DOORS

- A. Core: Structural Composite Lumber.
- B. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before faces are applied.
- C. Subject to compliance with requirements, provide manufacturer and product from one of the following:
 - 1. Algoma Hardwoods, Inc. "SCLC-5, 20 Minute".

2.4 FIRE-RATED DOORS:

- A. Construction: Manufacturer's standard 5-ply, mineral-core, construction as needed to provide fire rating indicated.
- B. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware and as follows:
 - 1. 5-inch top-rail blocking.
 - 2. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - 3. 5-inch midrail blocking, in doors indicated to have armor plates.
 - 4. 5-inch midrail blocking, in doors indicated to have exit devices.
- C. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.
- D. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.
- E. Subject to compliance with requirements, provide manufacturer and product from one of the following:
 - 1. Algoma Hardwoods, Inc. "FD Series Mineral Core Fire Door".

2.5 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors:
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Flush rectangular beads.
 - 3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings: Manufacturer's standard frame formed of cold-rolled steel sheet; factory primed.
 - 1. Profile: Flush rectangular beads.
- C. Metal Frames for Light Openings in Fire Doors: Manufacturer's standard frame formed of 0.0478-inch-thick, cold-rolled steel sheet; factory primed and approved for use in doors of fire rating indicated.
- D. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 - 1. Comply with clearance requirements of referenced quality standard for fitting. 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. In addition to typical door and frame hardware, coordinate and factory prepare doors as required for security devices and all other building systems devices.
 - 2. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Louvers: Factory install louvers in prepared openings.

2.7 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces and edges of doors, including cutouts, with one coat of wood primer specified in Division 09 Section "Painting."

2.8 FACTORY FINISHING

- A. 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 that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
 - 3. Staining, Effect (filled or unfilled), and Sheen: Match Architect's sample.
- D. Opaque Finish:
 - 1. Grade: Custom.
 - 2. Finish: Manufacturer's standard finish with performance comparable to AWI System OP-2 catalyzed lacquer.
 - 3. Color: Match Architect's sample.
 - 4. Sheen: Satin, unless otherwise indicated.

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 08 Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
 - a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

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 do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

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SECTION 08 31 13 – ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings:
 - 1. Detail fabrication and installation of access doors and frames for each type of substrate.

1.2 QUALITY ASSURANCE

- A. Obtain access doors for entire project from one source from a single manufacturer.
- B. Fire-Resistance Ratings: Wherever access doors are required in construction where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating shown.
 - 1. Provide UL label on each fire-rated access door.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- D. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.3 PROJECT CONDITIONS

- A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of Milcor Limited Partnership. Provided compliance with requirements, products of the following manufacturers will also be acceptable:
 - 2. Nystrom, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

2.5 ACCESSORY MATERIALS

- A. Frame Anchors: Same material as door face.
- B. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Polyamide Epoxy Coating: Two-part, high-build, fast curing epoxy.
 - 1. Solids: 83 percent +/- 2 percent by weight.
 - 2. VOC: <100 g/L.

2.6 FABRICATION

- A. Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.
- B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
- C. Frames: Fabricate from nominal 0.060 inch, 16-gage steel sheet.
 - 1. Fabricate frame with exposed flange nominal 1-inch wide around perimeter of frame (Milcor Style M) for units installed in exposed concrete, masonry, and ceramic tile finishes.
 - 2. For gypsum drywall, furnish perforated frames with drywall bead (Milcor Style DW).
- D. Flush Panel Doors: Fabricate from not less than nominal 0.075 inch, 14-gage steel sheet, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees. Finish with manufacturer's factory-applied prime paint.
 - 1. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
- F. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
 - 1. Provide one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike, unless otherwise scheduled.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical or applied 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions for installation of access doors.
- B. Coordinate installation with work of other trades.
- C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

3.2 ADJUST AND CLEAN

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

END OF SECTION 08 31 13

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SECTION 08 34 73 - SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal according to HMMA 803 and without coatings.

1.2 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound-control door assemblies that have been fabricated and tested as sound-retardant units, are identical to assemblies tested according to ASTM E 90 by an independent testing agency, and have the following minimum certified STC rating according to ASTM E 413:
 - 1. STC Rating: 33.

1.3 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Include sound ratings, construction and hardware preparation details, material and gasketing descriptions, core descriptions, label compliance, dimensions of individual components and profiles, and finishes for sound-control door assemblies.
- E. Shop Drawings: In addition to requirements below, provide a schedule of doors and frames using same reference numbers for details and openings as those on Drawings.
 - 1. Elevations of each door design.
 - 2. Details of sound-control seals, door bottoms, and thresholds.
 - 3. Details of doors including vertical and horizontal edge details.
 - 4. Frame details for each frame type including dimensioned profiles.
 - 5. Details and locations of reinforcement and preparations for hardware.
 - 6. Details of each different wall opening condition.
 - 7. Details of anchorages, accessories, joints, and connections.
 - 8. Details of glazing frames and stops showing glazing.
- F. Samples for Initial Selection: For units with factory-applied color finishes.
- G. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
- H. Product Certificates: For each type of sound-control door assembly, signed by product manufacturer.
- I. Qualification Data: For Installer.
- J. Field quality-control test reports.
- K. Product Test Reports: Based on evaluation of comprehensive sound-rating tests performed by a qualified testing agency, for each type of sound-control door assembly.
- L. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.
- M. Warranty: Special warranty specified in this Section.

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. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.
- C. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, through one source from a single manufacturer.
- D. Safety Glass: Category I or II materials complying with testing requirements in 16 CFR 1201.
- E. Preinstallation 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. Deliver doors and frames 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 wood doors.
- B. Deliver frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (100-mm-) high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install sound-control wood doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

- A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet sound rating requirements.
 - b. Faulty operation of sound seals.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
 - d. Wood doors that are warped (bow, cup, or twist) more than 1/4 inch (6 mm) in a 42-by-84-inch (1067-by-2134-mm) section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span.
 - 2. Warranty Period for Wood Doors: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY MANUFACTURER

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on model indicated in the drawings. Provided compliance with requirements, products of the following manufacturer will also be acceptable:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sound-Control Door Assemblies with Wood Doors:
 - a. Ambico Limited.
 - b. Krieger Steel Products Co.
 - c. Overly Door Company.
 - d. Security Acoustics; Div. of Security Metal Products Corp.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, 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 sound-control door frames of type indicated.
- F. Grout: Comply with Division 04 Section "Unit Masonry."
- G. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for sound-control door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- H. Mineral Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6 to 12 lb/cu. ft. (96 to 192 kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

2.3 WOOD DOORS

- A. Provide flush-design wood doors, not less than 1-3/4 inches (44 mm) thick; with manufacturer's standard sound-retardant core as required to provide STC rating indicated. Fabricate wood doors with tolerances according to WDMA 1.S.1-A.
- B. Comply with Division 08 Section "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements, unless otherwise indicated.
- C. Stiles: Same species as faces.
- D. Cores: Complying with ANSI A208.1, Grade LD-2.
- E. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware and as follows:
 - 1. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - 2. 5-inch (125-mm) bottom-rail blocking in doors and doors indicated to have protection plates.
 - 3. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
 - 4. 4-1/2-by-10-inch (114-by-250-mm) lock blocks

5. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

2.4 PANELS

- A. Provide sound-control panels of same materials, construction, sound rating, and finish as specified for adjoining sound-control wood doors.

2.5 STEEL FRAMES

- A. General: Fabricate sound-control door frames of full-welded unit construction, with corners mitered, reinforced, and continuously welded full depth and width of frame. Knocked-down frames are not acceptable.
 1. Interior Frames: Formed from minimum 0.067-inch- (1.7-mm-) thick, cold-rolled steel sheet, unless otherwise indicated.
- B. Hardware Reinforcement: Fabricate reinforcement plates from same material as door frame to comply with the following minimum sizes:
 1. Hinges: Minimum 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (150 mm) longer than hinge, secured by not less than 6 spot welds.
 2. Strikes, Flush Bolts, and Closers: Minimum 0.093 inch (2.3 mm) thick.
 3. Surface-Mounted Hardware: Minimum 0.093 inch (2.3 mm) thick.
- C. Head Reinforcement: Minimum 0.093-inch- (2.3-mm-) thick, steel channel or angle stiffener.
- D. Jamb Anchors:
 1. Stud Wall Type: Designed to engage metal stud, welded to back of frames; formed of same material as frame, not less than 0.042 inch (1.0 mm) thick.
 2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) 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.
- E. Floor Anchors: Formed of same material as door frame, not less than 0.067 inch (1.7 mm) thick, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- F. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide steel.
- G. Miscellaneous Components: Fabricated from hot- or cold-rolled steel sheet.

2.6 DOOR HARDWARE

- A. General: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC rating indicated.
- B. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- C. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- D. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
 1. Mounting: Mortised or semimortised into bottom of door or surface mounted on face of door as required by testing to achieve STC rating indicated.
- E. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.

- F. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.
- G. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum.
 - 1. Finish: Clear anodic finish.

2.7 FABRICATION

- A. General: Fabricate sound-control door assemblies to be rigid and free of defects, warp, or buckle. 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.
 - 1. Glazed Lites: Factory cut openings in sound-control doors.
- B. Wood Doors: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to referenced quality standard, unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
 - 1. Comply with clearance requirements in NFPA 80 for fire-rated doors.
- C. Steel Frames: Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 - 2. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
 - 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) in height.
 - 2) Four anchors per jamb from 60 up to 90 inches (1524 up to 2286 mm) in height.
 - 3) Five anchors per jamb from 90 up to 96 inches (2286 up to 2438 mm) in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
 - 5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal stud partitions.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - 5. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
- D. Hardware Preparation:
 - 1. SteelFrames: Factory prepare sound-control doors and frames to receive templated mortised hardware, including providing cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - a. Reinforce doors and frames to receive non-templated mortised and surface-mounted door hardware.
 - b. Comply with HMMA 830, "Hardware Preparation and Locations for Hollow Metal Doors and Frames."
 - c. Locate door hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

2. Wood Doors: Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.

2.8 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish sound-control steel door assemblies after assembly.
- B. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
- D. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2.9 WOOD FINISHES

- A. Finish sound-control wood doors after assembly.
- B. Factory finish sound-control wood doors to match doors specified in Division 08 Section "Flush Wood Doors."

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 sound-control door assemblies.
 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.
 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames for squareness, alignment, twist, and plumb to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Frames: Install sound-control door frames in sizes and profiles indicated.
 - 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. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, make splice smooth, flush, and invisible on exposed faces.
 - b. Install sound-control frames with removable glazing stops located on secure side of opening.
 - c. Remove temporary braces only after frames or bucks have been properly set and secured.
 - d. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - e. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
 - f. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - 1) Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
 - g. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 2. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, 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 above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 - 3. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.
 - 1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
 - a. Jambs: 1/8 inch (3 mm).
 - b. Head with Butt Hinges: 1/8 inch (3 mm).
 - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch (9.5 mm).
 - d. Sill: Manufacturer's standard.
 - e. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
- D. Sound-Control Seals: Where seals have been prefit and preinstalled in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

- E. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.
- F. Thresholds: Set thresholds in full bed of sealant complying with requirements in Division 07 Section "Joint Sealants."
- G. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and sound-control door assembly manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c., and not more than 2 inches (50 mm) o.c. from each corner.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent acoustical testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Acoustical testing and inspecting agency shall select one sound-control door at random from sound-control door assemblies that are completely installed and perform testing for verification that assembly complies with STC rating requirements.
 - 1. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field STC values shall be within 5 dB of laboratory STC values.
 - 2. Inspection Report: Testing and inspecting agency shall submit report in writing to Architect and Contractor within 24 hours after testing.
- C. Remove and replace sound-control door assemblies where test results indicate that they do not comply with specified STC rating requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and adjust operating hardware items just before final inspection. Leave work in complete and proper operating condition.
- B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 - 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
- C. Clean grout off sound-control door frames immediately after installation.
- D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 08 34 73

SECTION 08 41 36 – INTERIOR ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings: For entrance and storefront systems. Show details of fabrication and installation, including plans, elevations, sections, and details of components, provisions for expansion and contraction, and attachments to other work.
- E. Samples for Initial Selection: Color match to existing KI Wall System color Pebble.
- F. Cutaway Sample: Of each vertical-to-horizontal framing intersection of systems, made from minimum 6-inch (150-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Structural-sealant joints.

1.2 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.
- C. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.
- D. 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.
- E. Preconstruction Sealant Testing: Perform sealant manufacturers' standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants and each condition required by system.
 - 1. Test a minimum of 8 samples of each metal, glazing, and other material.
 - 2. Prepare samples using techniques and primers required for installed systems.
 - 3. Perform tests under environmental conditions that duplicate those under which systems will be installed.
 - 4. For materials that fail tests, determine corrective measures required to prepare each material to ensure compatibility with and adhesion of sealants, including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.
- F. 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.

- G. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code-Aluminum."

1.3 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.4 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures including, but not limited to, excessive deflection.
 - 2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 3. Failure of operating components to function normally.
 - 4. Warranty Period: Five years from date of Substantial Completion.
- C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of Kawneer Company, Inc., "Tri-Fab 450". Provided compliance with requirements, products of the following manufacturers will also be acceptable:
 - 1. Arrowall
 - 2. United States Aluminum.
 - 3. Oldcastle Glass; Vistawall Architectural Products.
 - 4. YKK AP America, Inc.
 - 5. EFCO Corporation.
- B. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
 - 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

- B. Steel Reinforcement: Complying with ASTM A 36 (ASTM A 36M) for structural shapes, plates, and bars; ASTM A 1008 (ASTM A 1008M) for cold-rolled sheet and strip; or ASTM A 1011 (ASTM A 1011M) for hot-rolled sheet and strip.
- C. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- D. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- E. Structural Silicone Sealant: Type recommended by sealant and system manufacturers that complies with ASTM C 1184 requirements, is compatible with system components with which it comes in contact, and is specifically formulated and tested for use as a structural sealant.
 - 1. Color: Clear
 - 2. Tensile Strength: 100 psi (689.5 kPa) minimum.
 - 3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by structural-sealant-glazed systems' design.
- F. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- G. Polyamide Epoxy Coating: Two-part, high-build, fast curing epoxy.
 - 1. Solids: 83 percent +/- 2 percent by weight.
 - 2. VOC: <100 g/L.

2.3 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
 - 2. Bottom Rail Design: 10 inches high meeting requirements of ICC/ANSI A117.1.
 - 3. Stile Design: To match existing KI Wall System.
- B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide 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. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

2.4 FABRICATION

- A. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. 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.
- F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with polyamide epoxy coating.
- H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- I. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Interior Doors: Provide ANSI/BHMA A156.16 silencers at stops to prevent metal to metal contact. Provide 3 silencers on strike jamb of single-door frames and 2 silencers on head of double-door frames.

2.5 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. 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.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.
 - 1. Color: Match existing wall system.

2.6 STEEL PRIMING

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.
- B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.
- C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with polyamide epoxy coating.
- C. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- D. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
 - 1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
- E. Install glazing to comply with requirements of Division 08 Section "Glazing," unless otherwise indicated.
 - 1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2. Install structural silicone sealant according to sealant manufacturer's written instructions.
 - 3. Mechanically fasten glazing in place until structural sealant is cured.
 - 4. Remove excess sealant from component surfaces before sealant has cured.
- F. Install perimeter sealant to comply with requirements of Division 07 Section "Joint Sealants," unless otherwise indicated.
- G. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm). Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to provide tight fit at contact points and for smooth operation.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 41 36

SECTION 08 42 43 - ICU/CCU ENTRANCE DOORS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrance doors.
- E. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other Work.
- F. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Aluminum Extrusions: 12-inch- long sections of extrusions or formed shapes.
 - 2. Glazed Panels: 12 inch square samples of glazing panels with integral light control (blinds) and solid panels.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the entrance door manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer's Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Source Limitations: Obtain entrance doors through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance doors and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 00 and 01 Sections.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Welding Standards: Comply with AWS D1.2, "Structural Welding Code--Aluminum."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Sections.

1.3 PROJECT CONDITIONS

- A. Field Measurements: Verify entrance door openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating entrance doors without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.4 COORDINATION

- A. Coordinate size and location of recesses in concrete floors for recessed sliding tracks for entrance doors. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.5 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of the entrance door system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Lateral deflection of glass lite edges in excess of 1/175 of their length or 3/4 inch, whichever is less.
 - 2. Faulty operation of hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal use.
- C. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on "Profiler ICU/CCU" Trackless Manual Sliding Doors" by Horton Automatics, Division of Overhead Door Corp.
 - 1. Provide units with emergency breakout feature at both fixed and sliding door leaves.
 - 2. Provide units with positive latching device in each sliding leaf.
- B. Provided compliance with requirements, products of the following manufacturers will also be acceptable:
 - 1. ASSA Abloy Entrance Systems.
 - 2. Dor-O-Matic; an Allegion.
 - 3. Nabco Entrances, Inc.
 - 4. Stanley Access Technologies.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with standards indicated below:
 - 1. Extruded: ASTM B 221.
 - 2. Sheet and Plate: ASTM B 209.
 - 3. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Glazing: Factory glaze sliding doors with 1/4" clear tempered safety glass.

- C. Glazing: Factory glaze sliding doors with "Light Control" (integral blinds) dual-pane glass in upper panels and 1/4" clear tempered safety glass in bottom panels.
 - 1. Light Control Units:
 - a. Manufacturer's standard 1 inch units with dual pane glass enclosing adjustable horizontal blinds which are operated by a corner-mounted knob.
- D. Sealants and Joint Fillers: Refer to Division 07 Section "Joint Sealants" for joints at perimeter of entrance system.
- E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.
- F. Polyamide Epoxy Coating: Two-part, high-build, fast curing epoxy.
 - 1. Solids: 83 percent +/- 2 percent by weight.
 - 2. VOC: <100 g/L.

2.3 ICU/CCU ENTRANCE DOOR ASSEMBLIES

- A. Provide ICU/CCU entrance door assembly, complete with doors, sidelite framing, and accessories, and in configurations indicated on Drawings. Comply with the following:
 - 1. Emergency Breakaway Capability: Doors and sidelites.
 - 2. Floor Track Configuration: Trackless across door opening and at sidelites.
- B. Opening Force: Provide entrance doors that require no more than 5 lbf to stop door movement.
- C. Air Infiltration Rating: When tested in accordance with UL 1784 - Air Leakage Test of Door Assemblies, maximum leakage rate at ambient temperature shall not exceed 1 CFM/ft² of opening at 0.3 in. of water.
 - 1. At 400°F the rate of leakage shall not exceed 1 CFM/ft² of opening at 0.3 in. of water.

2.4 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4-inch- thick glazed doors with minimum 0.125-inch-thick, extruded tubular stile and rail members. Fabricate corners with mechanically fastened reinforcing brackets or by welding. Incorporate concealed tie-rods that span full length of top and bottom rails.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on, extruded-aluminum, square glazing stops and preformed resilient glazing gaskets.
 - 2. Stile Design: As indicated on Drawings.
 - 3. Rail Design: As indicated on Drawings.
 - 4. Muntin Bars: As indicated on the drawings. .
- B. Framing Members: Fabricated from extruded-aluminum or formed-aluminum sheet or plate.
 - 1. Main Extrusions: Minimum wall thickness of 0.125 inch.
 - 2. Extruded Glazing Stops and Applied Trim: Minimum wall thickness of 0.062 inch.
 - 3. Muntin Bars: Horizontal tubular rail members for sidelites; match stiles and rails.
- C. Headers: Fabricated from minimum 0.125-inch- thick, extruded aluminum or formed-aluminum sheet or plate. Conceal roller track in header, providing access by means of hinged or removable access panel to permit service and adjustment. Secure panel to prevent unauthorized access.
 - 1. Concealed: Fabricate header to match depth of framing and to extend full width of door opening.
 - 2. Surface Mounted: Manufacturer's standard case, sized to extend full width of door opening.
 - 3. Capacity: Capable of supporting doors up to 100 lb per leaf.

- D. Carrier Assembly and Overhead Roller Track: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
 - 1. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
- E. Floor Track: Manufacturer's standard track and concealed bottom guide roller of configuration indicated.
- F. Brackets and Reinforcements: Manufacturer's standard; compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding; compatible with adjacent materials.
 - 1. Reinforcement: Reinforce members as required to retain fastener threads.
 - 2. Exposed Fasteners: Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.

2.5 HARDWARE

- A. Heavy-Duty Hardware: Provide units as indicated in sizes, number, and type recommended by manufacturer for entrances required. Finish exposed parts to match door finish, unless otherwise indicated.
- B. Emergency Breakaway Hardware: Provide release hardware that allows panel to swing out in the direction of egress to a full 90 degrees from sliding mode as indicated. Maximum force to open panel shall be 50 lbf.
 - 1. Release Position: Doors fully open.
 - 2. Release Position: Doors in any position.
- C. Limit Arm: Provide limit arm to control doors in the swing mode.
- D. Manual Flush Bolts: ANSI/BHMA A156.16, edge-mortised, lever-extension-type flush bolts. Locate flush bolts at bottom of inactive leaves of ICU/CCU doors.
- E. Surface Pulls: Provide all metal "U" shaped pull grips.
- F. Positive Latch Release Handle: Stainless Steel with No. 4 finish.

2.6 FABRICATION

- A. Fabricate entrance door assembly components to designs, sizes, and thicknesses specified and to comply with indicated standards.
- B. Prefabrication: Provide entrance doors as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
 - 1. Do not drill and tap for surface-mounted hardware items until time of installation at Project site.
 - 2. Perform fabrication operations, including cutting, fitting, forming, drilling, and grinding of metalwork in manner that prevents damage to exposed finish surfaces. For hardware, perform these operations before applying finishes.
 - 3. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
 - 4. Prepare components to receive concealed fasteners and anchor and connection devices.
 - 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

- C. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. 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.
- D. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
- E. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- F. Hardware: Install hardware, except surface-mounted hardware, at fabrication plant. Remove only as required for final finishing operation and for delivery to and installation at Project site.
- G. Doors: Fabricate doors in profiles indicated. Reinforce as required to support imposed loads and for installing hardware. Factory assemble door and frame units.
- H. Framing: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints according to manufacturer's standards. Provide subframes and reinforcement of types indicated or, if not indicated, as required for a complete system to support required loads.
- I. Electrical Grounding: Fabricate entrance doors to be internally grounded, complying with requirements of authorities having jurisdiction.

2.7 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Templates and Diagrams: Furnish templates, diagrams, and other data to fabricators and installers of related work, as necessary for coordinating entrance door installation.
- B. Recessed Floor Track: Level recess using nonshrink grout.

3.3 INSTALLATION

- A. Comply with entrance door manufacturer's written installation instructions, unless more stringent requirements are indicated. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with polyamide epoxy coating.
- C. Entrances: Install entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place. Lubricate operating hardware and other moving parts.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set tracks, header assemblies, operating brackets, and guides level and true to location with anchorage for permanent support.
- D. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous floor tracks and flashing in a full sealant bed, unless otherwise indicated.
 - 2. Seal frame perimeter with sealant, unless otherwise indicated.

3.4 ADJUSTING

- A. Adjust door hardware for smooth and safe operation.
- B. Readjust doors after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles). Lubricate hardware and other moving parts.
- C. Test grounding system for compliance with requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

- A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in Division 08 Section "Glazing" for cleaning and maintaining glass.
- B. Provide final protection and maintain conditions, including limiting construction traffic, that ensure entrance doors are without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 42 43

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - 1. Door hardware for steel (hollow metal) doors.
 - 2. Door hardware for aluminum doors.
 - 3. Door hardware for wood doors.
 - 4. Door hardware for other doors indicated.
 - 5. Keyed cylinders as indicated.

- B. Related Sections:
 - 1. Division 6: Rough Carpentry.
 - 2. Division 8: Aluminum Doors and Frames
 - 3. Division 8: Hollow Metal Doors and Frames.
 - 4. Division 8: Wood Doors.
 - 5. Division 26 Electrical
 - 6. Division 28: Electronic Security

- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA)
 - 2. NFPA 101 Life Safety Code
 - 3. NFPA 80 -Fire Doors and Windows
 - 4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
 - 5. UL10C – Positive Pressure Fire Test of Door Assemblies
 - 6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
 - 7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
 - 8. ICC – International Building Code

- D. Intent of Hardware Groups
 - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
 - 2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

- E. Allowances
 - 1. Refer to Division 1 for allowance amount and procedures.

- F. Alternates
 - 1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

- A. Comply with Division 1.

1.3 SUBMITTALS:

- A. Comply with Division 1.

- B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

- C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

- D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

- F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
 - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
 - b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

- ##### B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

- ##### B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

- ##### A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

- A. Refer to Conditions of the Contract
- B. Manufacturer's Warranty:
 - 1. Closers: Ten years
 - 2. Exit Devices: Five Years
 - 3. Locksets & Cylinders: Three years
 - 4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

- A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
 - 1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 - 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 - 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<u>Item:</u>	<u>Manufacturer:</u>	<u>Approved:</u>
Hinges	Stanley	Bommer, McKinney
Continuous Hinges	Stanley	Select, ABH
Locksets	Best	Facility Standard
Cylinders	Best	Facility Standard
Exit Devices	Precision	Facility Standard
Closers	Stanley D-4550	Facility Standard
Push/Pull Plates	Trimco	Burns, Rockwood
Push/Pull Bars	Trimco	Burns, Rockwood
Protection Plates	Trimco	Burns, Rockwood
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Burns, Rockwood
Flush Bolts	Trimco	ABH, Burns
Coordinator & Brackets	Trimco	ABH, Burns
Threshold & Gasketing	National Guard	Reese, K.N. Crowder

2.2 MATERIALS:

- A. Hinges: Shall be Five Knuckle Ball bearing hinges
1. Template screw hole locations
 2. Bearings are to be fully hardened.
 3. Bearing shell is to be consistent shape with barrel.
 4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
 5. Equip with easily seated, non-rising pins.
 6. Non Removable Pin screws shall be slotted stainless steel screws.
 7. Hinges shall be full polished, front, back and barrel.
 8. Hinge pin is to be fully plated.
 9. Bearing assembly is to be installed after plating.
 10. Sufficient size to allow 180-degree swing of door
 11. Furnish five knuckles with flush ball bearings
 12. Provide hinge type as listed in schedule.
 13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
 14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
 15. UL10C listed for Fire rated doors.
- B. Geared Continuous Hinges:
1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
 2. Anti-spinning through fastener
 3. UL10C listed for 3 hour Fire rating
 4. Non-handed
 5. Lifetime warranty
 6. Provide Fire Pins for 3-hour fire ratings
 7. Sufficient size to permit door to swing 180 degrees

- C. Behavioral Healthcare Solutions shall include components specifically designed to be used as a complete operational system. A typical installation shall include:
1. Electrified Power Transfer hinge shall be:
 - a. Full-Surface angled aluminum anodized finished hinge.
 - b. Security screws provided standard with hinge.
 - c. Modified for Door Sensor Assembly.
 2. Door Sensor Assembly shall be:
 - a. Telescoping adjustable to accommodate various door sizes.
 - b. The DSA will be equipped with a field adjustable nuisance delay (factory default 3 seconds) adjustment settings preformed at the controller.
 3. Reset Keyswitch:
 - a. Wall mounted keyswitch (single gang box not included).
 - b. 1 ¼" mortise cylinder with stright cam as required
 4. Strobe Light:
 - a. Ceiling mounting Strobe Light (used with ceiling tiles).
 - b. Strobe Light with steel mounting plate.
 5. Controller & Power Supply, for applications with up to 12, 24 or 36 doors with the following elements:
 - a. Door Sensor (DSA) inputs.
 - b. Strobe output.
 - c. Reset Keyswitch inputs.
 - d. Console output.
 - e. Remote signal output (dry contact).
 - f. Remote signal output (12v)
 - g. Adjustable nuisance delay (factory preset 3 seconds)
 - h. Power requiremets 110v input
 - i. Factory installed cylinder.
 6. Console for Desk or Wall mounted provides remote real-time visual and audible status. Console to monitor 12, 24, or 36 Door Sensor Assemblies. Console Elements shall include:
 - a. LED (1 red/green per room).
 - b. Adjustable piezo alarm.
 - c. Remote siren output.
 - d. Console output.
 - e. Strobe output.
 - f. Reset keyswitch inputs.
 - g. Power requirements – 110v AC input
- D. Cylindrical Type Locks and Latchsets:
1. Tested and approved by BHMA for ANSI A156.2, Series 4000, Operational Grade 1, Extra-Heavy Duty, and be UL10C listed.
 2. Provide 9001-Quality Management and 14001-Environmental Management.
 3. Fit modified ANSI A115.2 door preparation.
 4. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
 5. Locksets to have anti-rotational studs that are thru-bolted
 6. Keyed lever shall not have exposed "keeper" hole
 7. Each lever to have independent spring mechanism controlling it
 8. 2-3/4 inch (70 mm) backset
 9. 9/16 inch (14 mm) throw latchbolt

10. Provide sufficient curved strike lip to protect door trim
11. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel alloy
12. Keyed lever to be removable only after core is removed, by authorized control key
13. Provide locksets with 7-pin removable and interchangeable core cylinders
14. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
15. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
16. Core face must be the same finish as the lockset.
17. Functions and design as indicated in the hardware groups.

E. Exit Devices:

1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
2. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking $\frac{3}{4}$ " through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Touchpad to be "T" style constructed of architectural metal with matching metal end caps.
8. Touchbar assembly on wide style exit devices to have a $\frac{1}{4}$ " clearance to allow for vision frames.
9. All exposed exit device components to be of architectural metals and "true" architectural finishes.
10. Provide strikes as required by application.
11. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
12. The strike is to be black powder coated finish.
13. Exit devices to have field reversible handing.
14. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
15. Provide 9001-Quality Management and 14001-Environmental Management.
16. Vertical Latch Assemblies to have gravity operation, no springs.
17. Approved Manufacturers
 - a. The following manufacturers will be approved contingent on meeting or exceeding the above performance criteria:
 - 1) Precision Manufactured by Stanley Security Solutions

F. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

G. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles

5. Conform to ANSI 117.1
 6. Maximum 2 7/16 inch case projection with non-ferrous cover
 7. Separate adjusting valves for closing and latching speed, and backcheck
 8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
 9. Full rack and pinion type closer with 1½" minimum bore
 10. Mount closers on non-public side of door, unless otherwise noted in specification
 11. Closers shall be non-handed, non-sized and multi-sized.
- H. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.
1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
 2. Provide fastener suitable for wall construction.
 3. Coordinate reinforcement of walls where wall stop is specified.
 4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered
- I. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.
1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
 2. Surface overhead stops shall be heavy duty bronze or stainless steel.
- J. Door Bolts: Flush bolts for wood or metal doors.
1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- K. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 2. Provide mounting brackets for soffit applied hardware.
 3. Provide hardware preparation (cutouts) for latches as necessary.
- L. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.
- M. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.
- 2.3 FINISH:
- A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products
 - B. Powder coat door closers to match other hardware, unless otherwise noted.
 - C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
- B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. 1 each Grand Masterkeys
 - 2. 4 each Masterkeys
 - 3. 2 each Change keys each keyed core
 - 4. 15 each Construction masterkeys
 - 5. 1 each Control keys
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
 - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 - 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 - 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 - 1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
 - 3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

<u>Code</u>	<u>Name</u>
AB	ABH Manufacturing Inc.
BE	Best Access Systems
NA	National Guard
PR	Precision
SD	Stanley Door Closers
ST	Stanley
TR	Trimco

Option List

<u>Code</u>	<u>Description</u>
CD	CYLINDER DOGGING
HT	HOSPITAL TIPS-STANDARD WEIGHT
S3	ANSI Strike Package
LBR	LESS BOTTOM ROD
CORMAX PATENTED KEYING	Cormax Patented Keying

Finish List

<u>Code</u>	<u>Description</u>
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
GREY	Grey
BLACK	Black
US26D	Chromium Plated, Dull
US32D	Stainless Steel, Dull

Hardware Sets

SET #100 - Office

Doors: 480, 482, 484

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Lockset	9K3-7AB15D PATD S3	626	BE
1 Wall Bumper	1270CVSV	626	TR
3 Door Silencers	1229A	GREY	TR

NOTE: Seals by aluminum frame manufacturer.

SET #101 - Corridor

Doors: 470M, 470N

8 Hinges	CB168 4 1/2 X 4 1/2	US26D	ST
1 Exit Device	2201 CD LBR	630	PR
1 Exit Device	2208 X 4908A CD LBR	630	PR
1 Rim Cylinder	12E-72 PATD CORMAX PATENTED KEYING	626	BE
2 Mortise Cylinder	1E-74 PATD CORMAX PATENTED KEYING	626	BE
2 Door Closer	CLD-4551 EDA	689	SD
2 Wall Bumper	1270CVSV	626	TR
1 Smoke Seal	5075B @ Head & Jambs		NA
1 Astragal Set	115 NA Set		NA

NOTE: Seals by aluminum frame manufacturer.

SET #102 - Debrief / Controlk

Doors: 470D, 470G, 470H, 470K, 475, 477

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Lockset	9K3-7R15D PATD S3	626	BE
1 Wall Bumper	1270CVSV	626	TR
3 Door Silencers	1229A	GREY	TR

NOTE: Seals by aluminum frame manufacturer.

SET #103 - Storage Pair - UL

Doors: 435, 437

8 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Set Auto Flush Bolts	3825L X 3815L	626	TR
1 Lockset	9K3-7D15D PATD S3	626	BE
1 Coordinator	3094 x Brackets x Filler Bar	BLACK	TR
2 Door Closer	CLD-4551 STD W/PA BRKT	689	SD
2 Overhead Stop	4420 Series	US32D	AB
1 Dustproof Strike	3910	626	TR
1 Smoke Seal	5075B @ Head & Jambs		NA
1 Astragal Set	115 NA Set		NA

SET #104 - Corridor Unequal Pair

Doors: 440A, 445A, 450A, 460B

8 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Flush Bolt	3917-12	626	TR
1 Flush Bolt	3917-24	626	TR
1 Exit Device	2308 X M4908A CD	630	PR
2 Mortise Cylinder	1E-74 PATD CORMAX PATENTED KEYING	626	BE
1 Door Closer	CLD-4551 EDA	689	SD
2 Wall Bumper	1270CVSV	626	TR
1 Dustproof Strike	3910	626	TR
1 Smoke Seal	5075B @ Head & Jambs		NA
1 Astragal Set	115 NA Set		NA

SET #105 - Skills & Tasks

Doors: 445B, 450B

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Passage Set	9K3-0N15D S3	626	BE
1 Door Closer	CLD-4551 EDA	689	SD
1 Overhead Stop	4420 Series	US32D	AB
1 Smoke Seal	5075B @ Head & Jambs		NA

SET #106 - ICU Doors

Doors: 470A, 470B, 470C, 470I, 470J, 470L

NOTE: All hardware by ICU Sliding door manufacturer.

SET #107 - Sim Storage

Doors: 467

8 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Flush Bolt	3917-12	626	TR
1 Flush Bolt	3917-24	626	TR
1 Lockset	9K3-7D15D PATD S3	626	BE
2 Wall Bumper	1270CVSV	626	TR
1 Dustproof Strike	3910	626	TR

SET #108 - Restroom

Doors: 477A

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Passage Set	9K3-0N15D S3	626	BE
1 Wall Bumper	1270CVSV	626	TR
3 Door Silencers	1229A	GREY	TR

SET #109 - Skills & Tasks

Doors: 440B, 460A

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Exit Device	2108 X 4908A CD	630	PR
1 Rim Cylinder	12E-72 PATD CORMAX PATENTED KEYING	626	BE
1 Mortise Cylinder	1E-74 PATD CORMAX PATENTED KEYING	626	BE
1 Door Closer	CLD-4551 EDA	689	SD
1 Wall Bumper	1270CVSV	626	TR
3 Door Silencers	1229A	GREY	TR

SET #110 - Storage

Doors: 431, 4D03

4 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Lockset	9K3-7D15D PATD S3	626	BE
1 Door Closer	CLD-4551 STD W/PA BRKT	689	SD
1 Wall Bumper	1270CVSV	626	TR
3 Door Silencers	1229A	GREY	TR

SET #111 - Lobby

Doors: 4H04, 4H05

4 Hinges	CB168 4 1/2 X 4 1/2	US26D	ST
1 Exit Device	2108 X 4908A CD	630	PR
1 Rim Cylinder	12E-72 PATD CORMAX PATENTED KEYING	626	BE
1 Mortise Cylinder	1E-74 PATD CORMAX PATENTED KEYING	626	BE
1 Door Closer	CLD-4551 EDA	689	SD
1 Overhead Stop	4420 Series	US32D	AB

SET #112 - Exam

Doors: 401, 403, 405, 407, 409, 413, 415, 417, 419, 421

3 Hinges	CB179 4 1/2 X 4 1/2	US26D	ST
1 Passage Set	9K3-0N15D S3	626	BE
1 Door Closer	CLD-4551 STD W/PA BRKT	689	SD
1 Wall Bumper	1270CVSV	626	TR

SET #113 - Pysch

Doors: 423, 425, 427, 429

4 Hinges	HT CB179 4 1/2 X 4 1/2	US26D	ST
1 Passage Set	SPSL-CLON16F	630	BE
1 Wall Bumper	1270CVSV	626	TR

END OF SECTION

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each glass product and glazing material indicated.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- F. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- G. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations: Obtain all units of each glass "Type" from the same primary-glass manufacturer.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.
- E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
 - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. AGC Glass Company North America, Inc.
 2. Cardinal Glass Industries.
 3. Cristacurva.
 4. Guardian Industries Corp.; SunGuard.
 5. NSG Group.
 6. Oldcastle BuildingEnvelope®.
 7. PPG Industries, Inc.
 8. Saint-Gobain Corporation
 9. Schott North America, Inc.
 10. Technical Glass Products (TGP).
 11. Viracon, Inc.

2.2 HEAT-TREATED FLOAT GLASS

- A. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated.

2.3 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide products that are compatible with one another and with other materials they 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.
- B. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Applications: At all butt joint glazing..

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; 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; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. 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 A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer 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).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.
 - 1. Where butt glazed, or other frameless application, is indicated for interior installations, fabricate glass lites to have a consistent, and maximum, 1/8 inch wide vertical joint.
- C. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, 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 system.
 - 3. Minimum required face or 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.

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. Glazing Channel Dimensions, as Indicated on Drawings: Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- 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. 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.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- F. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
 - 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.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

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 around perimeter of opening; not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these 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. Apply heel bead of elastomeric sealant where indicated.
- F. Do not remove release paper from tape until just before each glazing unit is installed.
- G. 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.
- H. 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 PROTECTION AND CLEANING

- 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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.8 MONOLITHIC GLAZING SCHEDULE

- A. Glass Type GL-1: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

END OF SECTION 08 80 00

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SECTION 08 81 13 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 DEFINITION

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.2 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each decorative-glass and glazing product indicated.
- E. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:
 - 1. Size and location of penetrations.
 - 2. Glazing method.
 - 3. Mounting method.
 - 4. Attachments to other work.
 - 5. Full-size details of edge-finished profiles.
- F. Glass Samples: For the following products, 12 inches square:
 - 1. Each type of decorative glass.
- G. Product Schedule: For decorative glass. Use same designations indicated on Drawings.
- H. Product Certificates: For each type of decorative glass, from manufacturer.
- I.
- J. Warranty: Sample of special warranty.
- K. Maintenance Data: For each type of decorative glass and each applied coating to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- C. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- D. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. Labeling: Permanently mark glazing with certification label of the SGCC. Indicate on label manufacturer's name, type of glass, thickness, and safety glazing standard that glass complies with.
- E. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.
- B. Retain packaging and sequencing numbers for decorative-glass units.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, 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.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

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 as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-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.

2.3 DECORATIVE GLASS TYPES

- A. Decorative Glass: Silk-screened glass with decorative glass paint or ink applied to glass surface and cured according to manufacturer's standard process.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass Company North America, Inc.
 - b. Guardian Industries Corp.
 - c. Pilkington North America.
 - d. Saint-Gobain Corporation.
 - e. Schott North America, Inc.
 - 2. Glass Type: Clear fully tempered float glass.
 - 3. Glass Thickness: 6.0 mm.
 - 4. Comply with requirements for safety glazing.
 - 5. Colors and Patterns: Match Architect's samples.
 - 6. For use in replacing the existing flake board at the elevator lobby. Reuse the existing clear anodized aluminum frame system.

- B. Decorative Glass : Sandblasted glass with decorative pattern applied uniformly, with abrasive particles forced through a high-pressure air nozzle, according to manufacturer's standard process.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass Company North America, Inc.
 - b. Guardian Industries Corp.
 - c. Pilkington North America.
 - d. Saint-Gobain Corporation.
 - e. Schott North America, Inc.
 - 2. Glass Type: Clear fully tempered float glass.
 - 3. Glass Thickness: Not less than 6.0 mm.
 - 4. Patterns: As indicated.
 - 5. Antifingerprint Coating: Protective coating recommended and provided by glass fabricator.
 - 6. Acid-Etched Finish: Acid etch glass with hydrofluoric and hydrochloric acids, evenly applied and maintaining detail of sandblasted pattern, according to manufacturer's standard process.

2.4 WOOD PRODUCTS: Comply with the following:

- 1. Softwood Plywood: DOC PS 1, Veneer core plywood with Type II adhesive).
- 2. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.

2.5 DECORATIVE-GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.
- B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.
 - 1. Finished Edge: Clean cut.
- C. Adhere decorative glass to plywood substrate with adhesive recommended by glass fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative-glass framing members, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Effective sealing between joints of decorative-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 orientation of outer surfaces as indicated on Drawings. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

- A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces.
- D. Set decorative glass in locations indicated on Drawings..

3.4 GLAZING, GENERAL

- A. Decorative Glass: Install glazing as specified in Division 08 section "Glazing."
- B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. 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.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. 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.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where length plus width is more 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.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.5 CLEANING AND PROTECTION

- A. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and 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. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 81 13

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SECTION 08 88 13 – FIRE-RESISTANT GLAZING

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- F. Samples: For each type of glass product; 12 inches square.
- G. Copy of sample warranty.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain all units of each glass "Type" from the same primary-glass manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."

1.3 WARRANTY

- A. General: Warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of the following listed manufacturers. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.
 - 1. NSG Group Fire Protection Glass.
 - 2. Safti First Fire-Rated Glazing Solutions.
 - 3. Schott North America.
 - 4. Technical Glass Products.
 - 5. Vetrotech Saint-Gobain North America.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
- C. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.3 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
 - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.
- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F temperature-rise limitation; and the fire-resistance rating in minutes.
- C. Fire-Protection-Rated Tempered Glass: 6-mm thickness, fire-protection-rated tempered glass; and complying with 16 CFR 1201, Category II.
- D. Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; and complying with 16 CFR 1201, Category II.
- E. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.

2.4 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 - 1. Provide sealant having a VOC content of 250g/L or less.
 - 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 GLAZING

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.
- B. 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.
- 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.
- 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.

3.2 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.

3.3 FIRE-PROTECTION-RATED GLAZING SCHEDULE

- A. Glass Type FPGL-: 45-minute fire-protection-rated glazing; laminated ceramic glazing or laminated glass with intumescent interlayers.

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Submit shop drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
 - 1. Include control and expansion joints in soffits and furr-downs.
- E. Submit product data for all mold and moisture resistant products including wall board and joint compound.
 - 1. Included test reports indicating performance under ASTM D 3273 and ASTM D 3274.

1.2 PERFORMANCE REQUIREMENTS

- A. **Structural Performance:** Provide gypsum board shaft-wall assemblies capable of withstanding **the full** air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
 - 1. Provide gypsum board shaft-wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.
 - 2. Air-pressure loads and deflection limits are specified in "Gypsum Board Shaft Wall" Article in Part 2.
- 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.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products.", UL's "Fire Resistance Directory.", or GA-600, "Fire Resistance Design Manual."
- 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.
 - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
- C. **Low Emitting Materials:** For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying 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."

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packaging, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Promptly remove defective materials from the Project Site.

1.4 PROJECT 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 or damp, or have been wet or damp at any time, panels that are moisture damaged, or 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 GYPSUM WALLBOARD GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. Provide gypsum wallboard complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
- B. Gypsum Wallboard: "Regular" Type, except where fire-resistive or special wallboard is required, as follows:
 - 1. Long Edges: Tapered.
 - 2. Thickness: 5/8 inch, unless otherwise indicated.
- C. Subject to compliance with requirements, products which may be incorporated in the Work where "Regular" gypsum wallboard is indicated include:
 - 1. "CertainTeed Regular Gypsum Board," CertainTeed.
 - 2. "ToughRock," GP Gypsum Corp.
 - 3. "Regular Gypsum Board," Gold Bond Building Products Div., National Gypsum Co.
 - 4. "Regular Gypsum Board"; Temple Inland Forest Products Inc.
 - 5. "SHEETROCK Brand Gypsum Panels," United States Gypsum Co.

2.3 FIRE-RESISTIVE GYPSUM BOARD

- A. Where UL 1 Hour fire-resistance rating is indicated on light gage metal framing, provide gypsum wallboard only from those manufacturers who have passed the appropriate UL fire resistance tests which include metal studs with base metal thickness intended for use on this project.
- B. Subject to compliance with requirements, products which may be incorporated in the Work where "Type X" gypsum wallboard is indicated include:
 - 1. "CertainTeed Type X"; CertainTeed.
 - 2. "ToughRock Fireguard," GP Gypsum Corp.
 - 3. "Fire-Shield"; Gold Bond Building Products Div., National Gypsum Co.
 - 4. "Fire Rated Regular Gypsum Board"; Temple Inland Forest Products Inc.
 - 5. "SHEETROCK Brand FIRECODE Core Type X Gypsum Panels"; United States Gypsum Co.

2.4 SPECIAL GYPSUM WALLBOARD

- A. Sag-Resistant Gypsum Wallboard: manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
 - 3. of the following:

2.5 TILE BACKER BOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated. Provide one of the following:
- B. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M.
 - 1. Thickness: 1/2 inch.
 - a. Where required in a fire-rated wall assembly, provide 5/8 inch thick Type X board.
 - 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 3. Subject to compliance with requirements, products which may be incorporated in the Work include:
 - a. CertainTeed Corp.; DiamondBack GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. National Gypsum Company, EXP Tile Backer Board.

2.6 SHAFT-WALL SYSTEM DESCRIPTION

- A. Performance Requirements, General: Provide gypsum board shaft wall systems complying with performance requirements specified, as demonstrated by pretesting manufacturer's corresponding stock systems.
- B. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies, including those incorporating elevator door and other framing, whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.
 - 1. Provide fire-resistance rated assemblies identical to those indicated by reference to GA file numbers in GA 600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listings of other testing and inspecting agencies acceptable to authorities having jurisdiction.
- C. Steel Framing: ASTM C 645, of profile, size, and base metal thickness required to produce assemblies complying with structural performance requirements, with sectional properties computed to conform with AISI "Specification for Design of Cold-Formed Steel Structural Members."
- D. Structural Performance Characteristics: Provide gypsum board shaft wall systems engineered to withstand the following lateral design loadings (air pressures), applied transiently and cyclically, for maximum heights of partitions required, within the following deflection limits, verified by pretesting for deflection characteristics:
 - 1. Lateral Loading: 5 psf unless otherwise indicated
 - 2. Lateral Loading: 7.5 psf for tiled walls
 - 3. Deflection Limit: 1/240 of partition height unless otherwise noted.
 - 4. Deflection Limit: 1/360 of partition height for tiled walls.
 - 5.
- E. Sound Attenuation Performance: Provide gypsum board shaft wall systems designed and pretested to achieve the following minimum ratings for sound transmission class (STC) per ASTM E 90.
 - 1. STC Rating: As indicated but not less than 35.

2.7 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- C. Hangers: As follows:
 - 1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 - 2. Rod Hangers: ASTM A 510, mild carbon steel.
 - a. Diameter: 1/4-inch.
 - b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
 - 3. Angle Hangers: ASTM A 653/A 653M, G60, hot-dip galvanized commercial-steel sheet.
- D. Furring Channels (Furring Members): Commercial-steel sheet with manufacturer's standard corrosion-resistant zinc coating.
 - 1. Steel Studs: ASTM C 645.
 - a. Minimum Base Metal Thickness: 0.0179 inch.
 - 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch.
 - 3. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
- E. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation; Drywall Furring 640 System.
 - c. USG Interiors, Inc.; Drywall Suspension System.

2.8 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: Use at outside corners, unless otherwise indicated.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
 - c. Expansion (Control) Joint.
 - d. 3/4 inch radius Bullnose Cornerbead: Use at inside and ceiling corners, unless otherwise indicated.

2.9 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Joint Treatment Materials:
 - 1. Joint Compound: Setting-type joint compound achieving a rating of 10 when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274.
 - 2. Joint Tape for Glass Mat Gypsum Board: 10-by-10 glass mesh.
 - 3. Joint Tape for Interior Gypsum Board: Paper.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members 20 gage, 0.033 inch thick, and heavier.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- D. Sound Attenuation Blankets: Comply with requirements in Division 09 Section "Acoustic Blanket Insulation."
- E. Acoustical Sealant: Comply with requirements in Division 07 Section "Joint Sealants."
 - 1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Outlet Putty Pads: At acoustically rated partitions, as indicated on Drawings, provide putty pads for electrical and communications boxes.
 - 1. Provide pads that maintain acoustical ratings when tested in accordance with ASTM C 919.
 - 2. Comply with Underwriters Laboratories® standards UL 263 and UL 1479.
- G. Drywall Primer: As recommended by gypsum panel manufacturer for sealing drywall panels prior to skim coat or paint application for Level 3, 4, or 5 finishes.

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

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. 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-on 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 gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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 support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
- E. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.4 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Where gypsum drywall is indicated at inside face of exterior walls, provide only special mold and mildew-resistant type board at those locations.
1. Use Mold And Moisture-Resistant Joint Treatment Materials at all locations where mold and mildew-resistant type board is installed.
- D. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- E. Install gypsum 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.
- F. 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.
- G. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. Attach gypsum panels to framing provided at openings and cutouts.
- I. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- J. Form control and expansion joints with space between edges of adjoining gypsum panels.
- K. Cover both faces of steel stud partition 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 open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
 - L. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 - M. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion 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 manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including electrical and communications boxes.
 1. Seal partitions above acoustical ceilings.
 - N. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - O. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
- 3.5 PANEL APPLICATION METHODS
- A. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing), according to the framing system manufacturer's requirements for spanning capability.
 - a. Comply with fire-resistance-rated assembly requirements.
 3. Stagger abutting vertical joints between boards not less than one framing member on opposite side of metal stud partitions.
 - a. Minimize end joints.
 4. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 3.6 TILE BACKER BOARD
- A. At showers, tubs, and other "wet" areas indicated to receive wall tile, provide one of the following tile backing boards:
 1. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install with 1/4-inch gap where panels abut other construction or penetrations.
 - B. At areas indicated to receive wall tile but not subject to wetting, install mold and moisture resistant board.
 - C. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.
- 3.7 INSTALLING TRIM ACCESSORIES
- A. 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. If not indicated, install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

- A. 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 those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840:
 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
 3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges.
 4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
 5. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface.
- E. Required Locations for Gypsum Board Finish Levels:

Gypsum Board Finish Level	Where Required	Notes
Level 1	In ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies	Ridges and tool marks in the joint compound are acceptable for Level 1
Level 2	Where water-resistant gypsum backing board panels form substrates for tile, and other locations indicated	
Level 3	Where gypsum board surfaces are indicated to receive medium- or heavy-textured finishes before painting	Primer is required for Levels 3, 4, and 5
Level 4	All paper-faced gypsum wallboard surfaces to receive wall covering, light texture, or flat paint except where Level 5 finish is indicated in Specifications or on Drawings	
Level 5	All glass-mat and paper-faced gypsum wallboard surfaces exposed to view in areas accessible to the public and patients including public and patient room toilets	Required where all semi-gloss or gloss finishes are indicated / not required in storage rooms, closets, and similar small spaces

- F. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.

- G. At all hourly rated smoke partitions, fire partitions, fire/smoke partitions, fire/smoke barriers and fire barriers, permanently mark both sides of wall construction above ceilings with the words "Fire and Smoke Barrier – Seal all penetrations to maintain rating". Include the specific hourly rating of the wall assembly.
 - 1. Use stencils to create red lettering at least two inches high with message repeated every 10 feet and with a two inch thick red horizontal line from the nearest lettering terminating at a two inch thick red vertical line indicating the extent of the rated partition unless otherwise required by Authorities Having Jurisdiction.
- H. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.

END OF SECTION 09 21 16

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SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each type of product.

1.2 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For dimpled steel studs and runners and firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. .

2.2 MANUFACTURER

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Cemco.
 - 2. Clark-Dietrich Building Systems.
 - 3. MarinoWare; Div. of Ware Industries, Inc.
 - 4. MBA Metal Framing.

2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Meeting requirements of ASTM C 645; C-channel, roll-formed from hot-dipped galvanized steel; complying with ASTM A 1003 and ASTM A 653 G40 or equivalent corrosion resistant coating.
- B. Steel Studs and Runners: ASTM C 645.
 - 1. For Non-Fire Rated Partitions, Minimum Base Metal Thickness: 0.015 inch (0.38 mm) or members that can show certified third-party testing in accordance with ICC-ES-AC86 that meets ASTM 645 Section 9.2.
 - a. ClarkDietrich Building Systems “ProSTUD 25”, and other manufacturers of equivalent products, in 25 Ga equivalent thickness, are also acceptable.

2. For All Fire Rated Partitions, Minimum Base Metal Thickness: 0.019 inch (0.48 mm) or members that can show certified third-party testing in accordance with ICC-ES-AC86 that meets ASTM 645 Section 9.2..
 - a. ClarkDietrich Building Systems “ProSTUD 20”, and other manufacturers of equivalent products, in 20 Ga equivalent thickness, are also acceptable.
 3. Depth: As indicated.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.
 1. Steel Network Inc.; VertiClip SLD or VertiTrack VTD Series.
 2. Superior Metal Trim; Superior Flex Track System (SFT).
 3. ClarkDietrich Building Systems SLP-TRK Slotted Deflection Track.
- E. Proprietary Firestop Track: 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:
 - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - b. Metal-Lite, Inc.; The System.
 - c. ClarkDietrich Building Systems SLP-TRK Slotted Deflection Track.
 2. Provide accessories, attachments, and all other components required by the track manufacturer to meet fire resistive designs indicated.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in lengths indicated.
 1. Galvanized Steel Sheet: Minimum thickness as follows:
 - a. 12 Ga, 0.108 inch (2.6 mm), 6 inch (150 mm) wide with threaded holes, minimum 0.200 inch useable thread per hole for grab bars and handrails.
 - b. 16 Ga., 0.064 inch.
 - c. 20 Ga., 0.040 inch
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base Metal Thickness: 25 Ga., 0.022 inch.
 2. Depth: 7/8 inch unless otherwise indicated.
- H. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
- I. Adjustable Wall Furring Brackets: Nominal 0.036 (0.91 mm), 20 gage galvanized steel with corrugated edges, 1 inch (25.4 mm) wide.
- J. Cold-Formed Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
 1. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 2. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch- diameter wire, or double strand of 0.0475 inch- diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- 2.4 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. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- A. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- B. Flat Hangers: Steel sheet, in size indicated on Drawings.
- C. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.5 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. 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-on 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 gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
 - 1. Install components fabricated in "Equivalent Thickness" in accordance with UL V450 or V438. or UL U419.
 - 2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.

2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track or proprietary deflection track.
 - b. Use proprietary firestop track at fire-rated partitions.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
 1. Where studs are installed directly against exterior walls or dissimilar metals, install foam-gasket isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
 2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - a. Terminate partition framing at suspended ceilings where indicated.
- D. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- E. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.
 1. Install two studs at each jamb, unless otherwise indicated.
 2. Install 20 Ga. Stud for runner track section (for cripple studs) at head and secure to jamb studs.
 3. At jambs of doors weighing in excess of 200 pounds (90.7 kg), install double studs of 20 Ga., 0.036-inch- (0.91 mm-) thickness.
 4. At all jambs of door frames install double studs of 16 Ga., 0.060 inch thickness.
 5. Install 16 Ga stud at head (for cripple studs) and secure to jamb studs.
 6. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- F. 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.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- B. 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 permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- D. 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.
- E. 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.

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching suspension system hangers to building structure.
 - 3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot.
- E. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. Full-size samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- long samples of exposed suspension system members, including moldings, for each color and system type required.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- H. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
 - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

1.3 DELIVERY, STORAGE, AND HANDLING

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

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel 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.

1.5 COORDINATION

- A. Coordinate layout and installation of acoustical panels 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.
 - 2. Smoke-Developed Index: 50.
- B. 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 MANUFACTURERS

- A. The notes and schedules in the documents establish manufacturer and model/design for ceiling panels required for the Project. Provide the products as indicated on the drawings unless Architect approves products of another manufacturer which complies with requirements for this project.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

- D. 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.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 - 1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.
- F. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1. Product is 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.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - 2. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - 3. U.B.C.'s "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings": U.B.C. Standard 25-2.

- 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. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
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. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 4. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

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

END OF SECTION 09 51 00

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SECTION 09 54 46 - FABRIC-WRAPPED SUSPENDED CEILING BAFFLES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each type of baffles edge, core material, and mounting indicated.
- E. Shop Drawings: For fabric-wrapped baffles. Include mounting devices and details; details at baffles joints, and corners; and details at ceiling and wall intersections. Indicate baffles edge and core materials.
 - 1. Include reflected ceiling plans showing baffles sizes and direction of fabric weave and pattern matching.
 - 2. Maintain two copies of all shop drawings, product data, and samples, manufacturer's specifications, recommendations, installation instructions, and maintenance data at the Project Site.
 - a. At Project Closeout, turn over both copies to the Architect who will transmit one copy to the Owner.
- F. 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. Baffle 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 Baffles: Approximately 36 by 36 inches, including joints and mounting methods.
- G. Coordination Drawings: Reflected ceiling plans 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:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access baffles.
- H. Product Certificates: For each type of fabric-wrapped ceiling baffle, from manufacturer.
- I. Warranty: Sample of special warranty.
- J. Maintenance Data: For fabric-wrapped ceiling baffles to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

1.2 QUALITY ASSURANCE

- A. Source Limitations: Obtain fabric-wrapped ceiling baffles from single source from single manufacturer.
- B. Fire-Test-Response Characteristics: Provide fabric-wrapped baffles 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 and NFPA 286.
- C. Preinstallation Conference: Conduct conference at Project site.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and fabric-wrapped, ceiling baffle manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and baffles in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fabric-wrapped ceiling baffles 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 fabric-wrapped ceiling baffles until a permanent level of lighting is provided on surfaces to receive fabric-wrapped ceiling baffles.
- C. Air-Quality Limitations: Protect fabric-wrapped ceiling baffles from exposure to airborne odors such as tobacco smoke, and install baffles under conditions free from odor contamination of ambient air.

1.5 WARRANTY

- A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fabric-wrapped wall baffles that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Fabric sagging, distorting, or releasing from baffles edge.
 - b. Warping of core.
- C. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FABRIC-WRAPPED SUSPENDED CEILING BAFFLES BAFFLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Akustika 25 Baffle by Filzfelt or comparable product by one of the following:
 - 1. Acoustical Baffles Systems (APS, Inc.).
 - 2. Acoustical Solutions, Inc.
 - 3. Armstrong World Industries.
 - 4. Conwed Designscape; an Owens Corning company.
 - 5. Decoustics Limited; a CertainTeed Ceilings company.
 - 6. Pinta Acoustic, Inc.
 - 7. Proudfoot Company, Inc. (The).
 - 8. Tectum Inc.
 - 9. Wall Technology, Inc.; an Owens Corning company.

- B. Fabric Wrapped Suspended Ceiling Baffle: Manufacturer's standard baffle construction consisting of facing material laminated to front face, edges, and back edge border of core of wool.
 - 1. Mounting: Manufacturers standard suspension hardware.
 - 2. Core: Manufacturer's standard.
 - 3. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
 - 4. Edge Profile: Square.
 - 5. Corner Detail in Elevation: Square
 - 6. Facing Material: As indicated on the Drawings.
 - 7. Nominal Overall Baffles Thickness: As indicated on Drawings.
 - 8. Baffles Width: As indicated on Drawings.

- C. Baffle Size: As indicated on Drawings.

2.2 MATERIALS

- A. Core Materials:
 - 1. Wool Board: Wool core with 100% wool designed felt.

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 baffles perimeter against warpage and damage.

- B. Wool Fiber Cores: Chemically harden core edges and areas of core where mounting devices are attached.

- C. Facing Material: Apply fabric fully covering visible surfaces of baffles; 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.
 - 2. 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 baffles.

- D. Dimensional Tolerances of Finished Baffles: 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 baffles, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of fabric-wrapped ceiling baffles.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Ceiling Baffles: Install fabric-wrapped baffles in locations indicated with surfaces and edges plumb to surface, edges level and in alignment with other baffles, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with fabric-wrapped baffle manufacturer's written instructions for installation of baffles using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor baffles securely to supporting substrate.
- C. Match and level fabric pattern and grain among adjacent baffles.
- D. Installation Tolerances: As follows:
 - 1. Variation from Plumb and Level: Plus or minus 1/16 inch.
 - 2. Variation of Baffles Joints from Hairline: Not more than 1/16 inch wide.

3.3 CLEANING AND PROTECTION

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean baffles on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that fabric-wrapped baffles are without damage or deterioration at time of Substantial Completion.
- D. Replace baffles that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 09 54 46

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but more than 11 inches long, of each resilient product color, texture, and pattern required.

1.2 DELIVERY, STORAGE, AND HANDLING

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

1.3 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Product and color: As indicated on the drawings

2.2 RUBBER BASE

- A. Rubber Wall Base: Products complying with ASTM F-1861 Type TS, Thermoset Vulcanized Rubber, and as follows:
 - 1. Height: 6 inches
 - 2. Minimum Nominal Thickness: 1/8 inch.
 - 3. Lengths: Coils in lengths standard with manufacturer but not less than 100 feet.
 - 4. Exterior Corners: Job-formed only.
 - 5. Interior Corners: Job-formed only.
 - 6. Ends: Premolded.
- B. Accessories: Unless otherwise indicated, provide the following:
 - 1. Carpet Edge Guard: Roppe # 38.
 - 2. Reducer Strip: Roppe # 21.
- C. Provide accessories in proper thickness to accommodate adjacent flooring materials.

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than one fourth the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Apply protective floor polish to stair accessory surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
 - a. Coordinate selection of floor polish with Owner's maintenance service.

END OF SECTION 09 65 13

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SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- E. Samples for Verification: Full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.
- F. Product Schedule: For resilient tile flooring. Use same designations indicated on Drawings.
- G. Qualification Data: For Installer.
- H. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 01.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F.
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.4 PROJECT CONDITIONS

- A. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.
- B. Test the concrete substrate for moisture according to ASTM F 1869.
 - 1. Ensure that moisture levels do not exceed 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in a 24-hour period.
 - 2. Do not test at temperatures below 50 deg F (10 deg C)
- C. Test the concrete substrate for relative humidity according to ASTM F 2170 using in situ probes.
- D. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- E. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient flooring during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- F. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. The notes and schedules in the Documents establish manufacturer and model/design required for the Project. Provide the products listed unless Architect approves products of other manufacturer specifically for this Project.
- B. RUBBER FLOOR TILE
 - 1. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or a comparable product by one of the following:
 - a. Flexco.
 - b. Mannington Mills, Inc.
 - c. Mondo America Inc.
 - d. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
 - e. VPI Corporation.
 - 2. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color
 - 3. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.
 - 4. Wearing Surface: Textured-hammered
 - 5. Thickness: 0.25 inch (6.4 mm).
 - 6. Size: As indicated on the drawings.
 - 7. Colors and Patterns: As indicated on the drawings

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring 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 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
 - 1. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

3.2 PREPARATION

- A. Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient flooring manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
 - 5. Perform other tests recommended by manufacturer.
- C. Proceed with installation only after substrates pass testing.
- D. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- E. Remove by grinding all curing agents, parting agents, and surface hardeners before installing resilient flooring products. Remove all paint, varnish, and other surface contaminants.
 - 1. Remove all markings on substrate that may bleed through the installed flooring.
 - 2. Do not use solvent-based strippers under any circumstances since residual solvents may prohibit satisfactory bond of flooring adhesives.
- F. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- G. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.
- H. Close spaces to traffic during floor covering installation.
- I. Close spaces to traffic for 48 hours after floor covering installation.

3.3 TILE INSTALLATION

- A. Comply with tile manufacturer's written installation instructions.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Install tiles and accessories after other finishing operations, including painting, have been completed.
- F. Where demountable partitions and other items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.
- G. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- H. 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 chalk or other nonpermanent, nonstaining marking device.
- I. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- J. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- K. Hand roll tiles according to tile manufacturer's written instructions.

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other 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 flooring manufacturer.
 - 1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.
 - a. Coordinate selection of floor polish with Owner's maintenance service.
 - 2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
 - 3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

- C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.
 - 2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION 09 65 19

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SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular, carpet tile.

1.2 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.

1.3 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.5 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.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings :

2.2 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.
 - 1. Adhesives 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."
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

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 Section 033000 "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 096813

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SECTION 09 81 00 - PLENUM BARRIER BOARD INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.

1.2 QUALITY ASSURANCE

- A. Pre-Installation Meetings: Conduct meeting at Project site. Agenda includes Project conditions, coordination with work of other trades and layout of items which penetrate plenum barrier board insulation.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Supply additional material (full-size plenum barrier boards) equal to 2% of the total plenum barrier area. Additional material should match Products installed and be packaged with protective covering for storage and identified with labels describing contents.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect plenum barrier board insulation from excessive moisture in shipment, storage, and handling. Protect edges from being crushed, dented or torn in shipment, storage, and handling. Deliver in protected pallets and store in a dry place with adequate air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of the following listed manufacturers. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.
 - 1. ROCKFON
 - 2. ROCKWOOL

2.2 MATERIALS

- A. Barrier Board Insulation: Stone wool insulation, provide Plenum Barrier Board™ by ROCKFON® or AIM Raised Access Floor Fire Barrier by ROCKWOOL having the following characteristics:
 - 1. Size: 24" x 48".
 - 2. Thickness: 1-1/2".
 - 3. Facing: Aluminum foil with fiber reinforcement.
 - 4. Density: 8.0 lbs/cu ft (actual density).
 - 5. Fire Class: Class A.
 - 6. Fire Performance:
 - a. UL 723 (ASTM E84) Flame Spread / Smoke Developed: no greater than 25/50.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, ceiling grid, ducts, pipes and conduits including suspension and bracing assemblies, with installers present, for conditions affecting performance of plenum barrier board insulation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install plenum barrier board insulation to form contiguous sound barrier above demising walls or under raised floors according to manufacturer's instructions.

3.3 REPAIR

- A. Remove damaged or compromised components or components that result in openings too large to be filled with non-hardening acoustic sealant; replace with undamaged components.

3.4 SITE QUALITY CONTROL

- A. Site Tests and Inspections: Inspect around and between installed plenum barrier boards and around penetrating elements and fill openings with non-hardening acoustic sealant.

END OF SECTION 09 81 00

SECTION 09 84 53 – SOUND BARRIER MULLION TRIM

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Sound Transmission: Provide sound barrier mullion trim systems with minimum STC 51 for single-sided installations according to ASTM E 413, as determined by testing according to ASTM E 90.
- B. Thermal Movement: Provide sound barrier mullion trim systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, at material surfaces.
- C. 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.
 - 1. Provide products which meet assembly fire rating of one hour in compliance with ANSI/UL 2079 and UL Joint System No. WW-S-1039.

1.2 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each component of mullion trim system indicated.
- E. Shop Drawings:
 - 1. Include typical dimensioned cross-section(s) at locations where drywall partition terminates at the perimeter aluminum framed glazing system indicating:
 - a. Dimensions.
 - b. Fastening.
 - c. Material finish.
- F. Samples for Verification: For each type of profile and exposed finish required.
 - 1. Size: 12 inches (304 mm).
- G. Qualification Data: For qualified Installer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
 - 1. Include UL 2079/S115 for fire-rated assemblies.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: ASTM E 90 testing to be performed by laboratory qualified according to ASTM E 699 for testing indicated and accredited by IAS as complying with ISO/IEC Standard 17025.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of mullion trim systems by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mullion trim systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packaging, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Keep materials dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Store and handle materials in a manner to prevent warping, twisting, and damage to finishes.

1.6 WARRANTY

- A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Provide written warranty as specified, signed by the manufacturer and installer, agreeing to remove, repair, and reinstall components of sound barrier mullion trim system work which fail in material or workmanship. Warranty work includes removal and replacement of related work which must be removed to properly replace sound barrier mullion trim system.
 - 1. Failures include, but are not limited to:
 - a. Failures due to incorrect or inadequate installation.
 - b. Noise or vibration caused by thermal movements.
 - c. Defects in accessories, seals, or sealants.
 - d. Deterioration of metal finishes and other materials beyond normal weathering.
 - 2. Warranty Period: Ten years from the date of Substantial Completion.
- C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products of MULL-it-OVER Products; Sound Barrier Mullion Trim Cap Systems.
- B. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products of other manufacturers will also be acceptable.

2.2 SOUND BARRIER MULLION TRIM SYSTEM

- A. Manufacturer's extruded- or formed-aluminum members of thickness required and reinforced as required to support imposed loads.

- B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Shape, and Tubes: ASTM B 221.
- C. Sound Barrier Mullion Trim Cap:
 - 1. MULL-it-OVER trim cap profile: 57 Classic Mullion Trim Cap.
- D. Snap-on Fastener Cover: Manufacturer's standard component of same material, and finish as trim cap.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - 1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
- F. Sound Absorbing Foam: Manufacturer's standard product.
 - 1. Surface-Burning Characteristics when tested according to ASTM E 84 as follows:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fungi Resistance: Zero rating when tested in accordance with ASTM G 21.
- G. Compressible Foam:
 - 1. Thickness: As indicated on the drawings.
 - 2. Color: Charcoal.
- H. Sealant: Acoustical sealant meeting requirements of Division 07 section "Joint Sealants."

2.3 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Sharp profiles, straight and free of defects or deformations.
 - 2. Accommodations for thermal and mechanical movements to prevent metal-to-metal contact.
 - 3. Produce components in lengths necessary to avoid visible field splicing.

2.4 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
 - 1. Install components plumb and true in alignment with established lines.
 - 2. Do not install damaged components.

3. Fit joints to produce hairline joints free of burrs and distortion.
4. Install anchors with isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
5. Seal joints watertight, unless otherwise indicated.

3.3 CLEANING

- A. Remove excess sealant and dirt from surfaces.
 1. Use only cleaning procedures and products recommended in writing by the sound barrier mullion trim manufacturer.
- B. Remove packaging, trash, and refuse created from installation procedures and dispose of legally.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure sound barrier mullion trim systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 84 53

SECTION 09 91 00 – PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Paint exposed surfaces, except where the documents indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, surfaces of mechanical and electrical equipment that do not have a factory-applied final finish, and factory-applied prefinished surfaces of certain equipment including, but not limited to; electrical panel covers, equipment supports, and equipment exposed to view on the roof.
 - 2. At "Unoccupied" interior spaces, painting is not required on prefinished items or finished metal surfaces.
- B. Do not paint operating parts, and labels.
 - 1. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 2. Do not paint over UL, FMG, or other code-required labels and warnings or equipment name, identification, performance rating, or nomenclature plates.

1.2 DEFINITIONS

- A. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.
 - 1. Substrate" as used herein means the surface to which paint is to be applied. In the case of previously painted existing surfaces, substrate means the surface to which the existing paint was applied.
- B. Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

Master Painters Institute, Inc. standards for gloss and sheen:

		Gloss at 60 degrees		Sheen at 85 degrees
Gloss Level 1	a traditional matte finish - flat	maximum 5 units	and	maximum 10 units
Gloss Level 2	a high side sheen flat - a 'velvet-like' finish	maximum 10 units	and	10-35 units
Gloss Level 3	a traditional 'eggshell-like' finish	10-25 units	and	10-35 units
Gloss Level 4	a 'satin-like' finish	20-35 units	and	minimum 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units		
Gloss Level 6	a traditional gloss	70-85 units		
Gloss Level 7	a high gloss	more than 85 units		

- C. "Interior Surfaces": Interior surfaces as used herein means all other interior surfaces, including surfaces in unconditioned areas that are not exposed to untreated outside air.

1.3 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- E. Samples for Initial Selection: For each type of finish-coat material indicated.
 - 1. After color selection, Architect will furnish color chips for surfaces to be coated.
- F. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 - 3. Submit samples on the following substrates for Architect's review of color and texture only:
 - a. Painted Gypsum Drywall: 12-inch- square Samples for each color and material on gypsum wallboard.
 - b. Ferrous and Non-Ferrous Metal: 4-inch- square Samples of flat metal and 8-inch-long Samples of solid metal for each color and finish.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft..
 - b. Small Areas and Items: Architect will designate items or areas required.
 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 3. Final approval of colors will be from benchmark samples.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.6 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

- A. Material Compatibility: 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.
1. 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.

- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: As indicated on the drawings.

2.2 INTERIOR PAINTING SCHEDULE

- A. Provide the following paint systems and number of coats for the various substrates indicated. Provide only the listed prime and finish coat materials unless different primer is recommended in writing by the finish coat paint manufacturer for each specific substrate.
 - 1. Where specific finish paint material is not indicated, refer to notes and finish schedules for finish paint material and gloss levels for each surface to be painted.
- B. Gypsum Drywall; 2 finish coats over Primer.
 - 1. Interior Latex Primer:
 - a. Behr: Premium Plus Drywall Primer 73.
 - b. Benj. Moore: Insl-x Aqua Lock Primer AQ 0400.
 - c. PPG: Speedhide High Build Latex Primer/Surfacers 6-4.
 - d. S-W: ProMar 200, Zero VOC Interior Latex Primer B28W2600.
- C. Low-Odor System for Gypsum Drywall; 2 low-odor finish coats over low-odor primer.
 - 1. Behr: Kilz PVA Interior Primer 10. / Premium Plus All-In-One Primer 75.
 - 2. Benj. Moore: Ultra Spec Primer #534.
 - 3. PPG: 9-2xx Pure Performance Interior Latex Primer
 - 4. S-W: ProMar 200, Zero VOC Interior Latex Primer B28W2600.
- D. Ferrous Metal; 2 finish coats of water borne semi-gloss acrylic latex enamel over primer:
 - 1. Waterborne Acrylic Primer:
 - a. Behr: Premium Plus Multi-Surface Primer 436.
 - b. Benj. Moore: SSHP Acrylic Metal Primer P04.
 - c. PPG: 90-712 Pitt Tech DTM Acrylic Primer/Finish.
 - d. S-W: Pro-Cryl Universal Water Based Primer B66-310.
- E. Interior Finish Coats:
 - 1. Interior Eggshell Acrylic Emulsion:
 - a. Behr: Behr Pro i300 Interior Eggshell 330.
 - b. Benj. Moore: Ultra-Spec Eggshell N538
 - c. PPG: Speedhide 6-4xx
 - d. S-W: ProMar 200 Zero VOC
- F. Low-Odor System Finish Coats:
 - 1. Low-Odor Interior Eggshell Acrylic Emulsion:
 - a. Behr: Behr Pro i300 Interior Eggshell 330.
 - b. Benj. Moore: Ultra Spec Eggshell N538.
 - c. PPG: 9-3xx Pure Performance Latex
 - d. S-W: ProMar 200 Zero VOC
 - e.

2.3 EPOXY PAINT

- A. Provide one of the following epoxy coating systems on scheduled substrates as indicated. Provide primer/sealer coat appropriate to each substrate as specifically recommended by the finish coat manufacturer.

- B. Interior Water Based Epoxy (Semi-Gloss Finish): 2 coats over primer.
 - 1. Finish Coats:
 - a. Behr: Pre-Catalyzed Waterborne Epoxy Semi-Gloss HP150.
 - b. Benj Moore Super Spec Acrylic Epoxy # 256.
 - c. PPG: Aquapon WB Epoxy 98 Series; 98-1 / 98-100
 - d. S-W: Pro Industrial Water Based Catalyzed Epoxy, B73 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Gypsum Board: Prime gypsum board surface to receive Level 3 or greater finish according to paint manufacturers written instructions.
 - 3. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean, unless more stringent preparation is recommended by paint system manufacturer, according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed to view in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Coat to cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are not acceptable.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- 3.4 FIELD QUALITY CONTROL
- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - a. Quantitative materials analysis.
 - b. Abrasion resistance.
 - c. Apparent reflectivity.
 - d. Flexibility.
 - e. Washability.
 - f. Absorption.
 - g. Accelerated weathering.
 - h. Dry opacity.
 - i. Accelerated yellowness.
 - j. Recoating.
 - k. Skinning.
 - l. Color retention.
 - m. Alkali and mildew resistance.
- B. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION 09 91 00

SECTION 10 21 23 – CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. **Flame-spread, Smoke Development and Flame-resistance Certification Letter: A signed and dated letter from the cubicle curtain manufacturer verifying that the flame spread and smoke developed ratings of the products provided meet the requirements of NFPA 101, 2003 edition and that submitted products have passed both the small- and large-scale tests of NFPA 701, Standard Methods of Fire Tests for Flame-Resistant textiles and Films, 1999 edition.**
- E. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of curtain material.
- F. Samples for verification purposes in manufacturer's standard size, showing full range of colors, textures, and pattern variations expected. Prepare samples from same material to be used for the Work. Submit the following:
 - 1. 18-inch square of each type of curtain material.
 - 2. 4-inch square of each type of mesh material.
- G. Submit Shop Drawings for Work of this section requiring coordination with work of other sections.
 - 1. Show full and complete details of the system, related construction and large scale reflected layout of ceiling areas showing location of all cubicle curtain tracks.
 - 2. Indicate in detail the materials, finishes, dimensions, thicknesses or gauges of all parts, reinforcement, where applicable, and anchorage including items of hardware and accessories necessary for complete installation.
 - 3. Verify conditions affecting the Work of this section and obtain accurate measurements covering all parts thereof for incorporation into shop drawings.
 - 4. Indicate utility connections, supports, anchorage, jointing, and reinforcement and include locating dimensions, materials, and finishes.

1.2 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide cubicle curtain tracks and I.V. tracks manufactured by one company for single source responsibility.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Protect finished surfaces from damage during storage, handling, and installation. Keep curtain fabric covered with polyethylene film or other protective covering during storage and after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials, construction, and finish conforming to requirements specified herein. Where material is not definitely specified, manufacturer's standard is acceptable, providing it is suitable for purpose intended. Provide all new materials, free from defects and imperfections that might affect serviceability and appearance of the finished product.
1. Aluminum alloy equivalent in ultimate tensile, yield and shear strengths to ASTM B 221, alloy 6063-T4 polished with anodized finish.
 2. Stainless steel, conforming to ASTM A 276, class 304 for welded construction, 302 or 304 for construction formed without welding.
 3. Chromium plating, apply over coated nickel. On brass and bronze, apply nickel coating either directly or over a coating of copper. On zinc alloy die castings, apply nickel coating over a coating of copper. Each coating shall completely cover surfaces that are visible after installation.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. ADC Hospital Equipment
 2. Kirsch Company
 3. Clickeze Corporation
 4. General Cubicle Company
 5. Imperial Fastener Company
 6. A. R. Nelson Company, Inc.
 7. Pryor Products
 8. Salisbury Industries

2.3 TRACK

- A. Track: Anodized, extruded aluminum.
1. Curves: Factory-fabricated, 12-inch radius, 90-degree and 45-degree bends.
 2. Splicing Clamp: Anodized aluminum sleeve matching track color.
- B. Track Accessories: Provide end caps, connectors, end stops, coupling sleeves, wall brackets, and other accessories as required for secure and operational installation. Provide a quantity of carriers for 6-inch spacing the entire length of curtain.
1. Carriers: Nylon rollers and axle with chrome-plated steel hook.

2.4 BREAK-AWAY TRACK AND CARRIERS

- A. Provide anodized aluminum track specifically designed for break-away slider tape carriers with no hooks.

2.5 CURTAINS

- A. Curtain Fabric: Inherently and permanently flame resistant for the life of the fabric. Launderable to a temperature of not less than 95 deg F.
1. Fire Performance Characteristic: Provide curtain fabric identical to that tested for the following fire performance requirement, according to test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Rating: Flame resistant.
 - b. Test Method: NFPA 701.
 2. Fabric: As indicated on the drawings
 - a. Pattern: As indicated on the drawings
 - b. Color: As indicated on the drawings

- B. Curtain Top: Not less than 20-inch-wide nylon mesh with overlapped seams, double-lock stitched to body of curtain. Bind sides and top of mesh with same fabric as body of curtain.
 - 1. Mesh: No. 40, heavy.
 - 2. Color: White.
- C. Fabrication: Provide curtains not less than 10 percent wider than length of track from which they hang, extending to 15 inches above the floor.
 - 1. Top Hem: Not less than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double stitched.
 - a. Grommets: Rolled-edge, rustproof, and spaced not more than 6 inches on center.
 - 2. Bottom and Side Hems: Not less than 1 inch wide, reinforced, double thickness, and single stitched.
 - 3. Seams: Not less than 1/2 inch wide, double turned and double stitched.
- D. Curtain Drop: Stainless steel beaded chain with aluminum hook.
- E. Curtain Drop: PVC strip with chrome-plated steel hook.
- F. Curtain Tie Back: Wall-mounted, nickel-plated brass chain.
- G. Operating Wand: 1/4-inch-diameter fiberglass baton in length required to extend to within 5 feet above finish floor maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine the substrate, conditions, utilities under which units of medical equipment are to be installed and notify Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- B. Coordination: Coordinate work of this Section with the related work of other sections to obtain proper installation of all items.

3.2 INSTALLATION

- A. Install units with clips and anchorages suited to mounting and substrate indicated.
- B. Install ceiling-mounted tracks secured at intervals of not less than 3 feet – 0 inches (900 mm).

3.3 ADJUSTING

- A. Adjust for unencumbered operation of hardware.

END OF SECTION 10 21 23

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SECTION 10 22 28 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. NIC: Noise isolation class.
- B. NRC: Noise reduction coefficient.
- C. NVLAP: National Voluntary Laboratory Accreditation Program.
- D. STC: Sound transmission class.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound Transmission Requirements: Operable panel partition assembly tested in a full-scale opening, 14 by 9 feet, for laboratory sound transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
 - 2. Noise Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound absorption performance according to ASTM C 423 and rated for not less than the NRC indicated.

1.3 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified. Include data on acoustical performance, surface-burning characteristics, and durability.
- E. Shop Drawings: Show location and extent of operable panel partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel. Show blocking to be provided by others. Include the following:
 - 1. Calculations: Calculate requirements for supporting operable panel partitions and verify capacity of carriers and track components to support loads; indicate deflection limits for partition and adjacent construction.
- F. Setting Drawings: For embedded items and cutouts required in other work, including support beam punching template.
- G. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
 - 1. Include similar Samples of accessories involving color selection.

- H. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color pattern or texture variations, include sample sets showing the full range of variations expected.
 - 1. Fabric: Full width by not less than 36-inch- long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
 - 2. Panel Edge Material: Not less than full width by 3 inches long.
- I. Product Certificates: Signed by manufacturers of operable panel partitions certifying that products furnished comply with requirements.
- J. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- K. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- L. Product Test Reports: From a qualified testing agency indicating that each operable panel partition complies with requirements, based on comprehensive testing of current products.
- M. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:
 - 1. Panel face finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - 2. Seals, hardware, track, carriers, and other operating components.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable panel partition manufacturer as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- C. Fire-Test-Response Characteristics: Provide operable panel partitions with the following fire-test-response characteristics, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.
 - 2. Fire Growth Contribution: Textile wall coverings complying with the acceptance criteria of UBC Standard 8-2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and storage dimensions and proceed with fabricating operable panel partitions without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on the following products of Modernfold, Inc., "Acousti Seal 900" Series
 - 1. Model 931, Individual panels.
 - a. STC: 50
- B. Provided compliance with requirements, products of the following manufacturers will also be acceptable:
 - 1. Advanced Equipment Corp.
 - 2. Foldoor; Panelfold, Inc..
 - 3. Hufcor Inc.
 - 4. Industrial Acoustics Co.
 - 5. Kwik-Wall Co.
 - 6. Moderco Inc.
 - 7. National Folding Wall Corp.

2.2 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer standard thickness.
- B. Gypsum Board: ASTM C 36.

2.3 FOLDING PANEL PARTITIONS

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
 - 1. Steel-Frame Panel Construction: Faced with gypsum board.
 - 2. Panel Construction: Manufacturer's standard panel construction complying with requirements indicated.
 - 3. Panel Weight: 11 lb/sq. ft. maximum.
 - 4. Panel Thickness: Not less than 3 inches.
 - 5. Edges: Manufacturer's standard edge.
 - 6. Initial Closure: Fixed jamb.
 - 7. Final Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
- B. Dimensions: Fabricate operable panel partitions, from manufacturer's standard sizes, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
- C. Cap-Trimmed Edges: Protective aluminum perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.
- D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

- E. Operable Panel Partition Characteristics: Comply with requirements indicated in the Operable Panel Partition Schedule at the end of Part 3.
- F. Trim: Manufacturer's standard aluminum trim, finished as follows:
 - 1. Clear anodized.
- G. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.4 SEALS

- A. Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
 - 1. Seals made from materials and profiles that minimize sound leakage.
 - 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, extruded-PVC or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - 1. Mechanically Operated: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than the 2-inch operating clearance between retracted seal and floor finish.

2.5 FINISH FACING

- A. Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Apply one-piece, seamless facings free from air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 - 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
 - 3. Match facing pattern 72 inches above finished floor.
- B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
- C. Paint: Manufacturer's standard factory-painted finish.
- D. Face Materials: As indicated on the drawings

2.6 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
 - 1. Center carrier stop.
- C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.
- D. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with ASTM E 557, operable panel partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Match operable panel partitions for color and pattern by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.3 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified testing laboratory to perform field tests and to prepare test reports.
- B. Testing Methodology: Test the installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than the NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- C. Repair or replace operable panel partitions within areas where test results indicate partitions do not comply with requirements, and retest partitions.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired, replaced, or additional work with specified requirements.

3.4 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.5 CLEANING AND PROTECTION

- A. Clean soiled surfaces, fabric facing, on completing installation of operable panel partitions, to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.
- C. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before 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 operable panel partitions.
1. Test and adjust seals, hardware, carriers, tracks, safety devices, and other operable components. Replace damaged or malfunctioning operable components.
 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 3. Review data in maintenance manuals. Refer to Division 01 Section "Contract Closeout."
 4. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
 5. Schedule training with Owner with at least seven days' advance notice.

END OF SECTION 10 22 28

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.
- E. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.
- F. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
 - 1. Wall and Corner Guards: 12-inch- long Samples of each type of impact-resistant wall protection system component required. Include examples of joinery, corners, and field splices.
 - 2. Sheet or Panels: 6-by-6-inch- square Samples of each impact-resistant wall protection system component required.
- G. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 01.
 - 1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl plastic finishes and performance.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.
- C. 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, or in-service performance.

- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection system and are based on the specific system indicated. Other manufacturers systems with equal performance characteristics may be considered. Refer to Division 01 Sections.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architects approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Fire-Test-Response Characteristics: Provide impact-resistant wall protection system components with the following surface-burning characteristics, as determined by testing materials identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify impact-resistant wall protection system components with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.
- F. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lb/in. of width when tested according to ASTM D 256, Test Method A.

1.3 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. To establish standards of manufacture, operation, performance, and appearance, drawings and specifications are based on products indicated on the drawings. . Provided compliance with requirements, products of other manufacturers may also be acceptable.
 - 1. American Floor Products Co., Inc.
 - 2. Arden Architectural Specialties, Inc.
 - 3. Balco, Inc.
 - 4. Boston Retail Products.
 - 5. Construction Specialties, Inc.
 - 6. IPC Door and Wall Protection Systems, Inc.
 - 7. Koroseal Wall Protection Systems, Inc.
 - 8. K. J. Miller Corp.
 - 9. Pawling Corporation.
 - 10. Tepromark International, Inc.
 - 11. Tri-Guards, Inc.
 - 12. Wilkinson Company, Inc.

2.2 MATERIALS

- A. Extruded Rigid Plastic: Textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.
 - 1. Color and Texture: Match Architect's samples.
 - 2. Color and Texture: As indicated by referencing manufacturer's designations.
 - 3. Color and Texture: As selected by Architect from manufacturer's full range for these characteristics.

- B. Plastic Sheet Wall Covering Material: Semirigid, textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic sheet; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.
 - 1. Color and Texture: Match Architect's samples.
 - 2. Color and Texture: As indicated by referencing manufacturer's designations.
 - 3. Color and Texture: As selected by Architect from manufacturer's full range for these characteristics.
- C. Aluminum Extrusions: Provide alloy and temper recommended by the manufacturer for the type of use and finish indicated, but with not less than the strength and durability properties specified in ASTM B 221 for alloy 6063-T5.
- D. Stainless-Steel Plate: Type 304, minimum 0.0625 inch.
- E. Fasteners: Provide aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theft proof fasteners where exposed to view.
- F. Adhesive: Type recommended by the manufacturer for use with material on the substrate indicated.

2.3 WALL GUARDS

- A. Bumper/Crash-Rail-Type Wall Guards: Assembly consisting of a snap-on-type rigid plastic cover installed over a continuous aluminum retainer mounted at height indicated. Model as indicated on the drawings.
 - 1. Cover: Extruded, rigid plastic, minimum 0.078 inch (2.0 mm) thick, in profile indicated.
 - 2. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.0625 inch thick; with continuous rubber or vinyl bumper cushion centered in the extrusion.
 - a. Mounting Type: Surface mounted flush on wall.
 - 3. Accessories: Provide prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, mounting hardware, and other accessories as required.
 - a. Provide end caps and inside and outside corners that match plastic cover color and are field adjustable for close alignment with snap-on plastic covers.

2.4 CORNER GUARDS

- A. Surface-Mounted, Resilient Plastic Corner Guards: Surface-mounted, resilient plastic corner-guard assembly consisting of a snap-on-type plastic cover installed over a continuous aluminum retainer, height as indicated. Model as indicated on the drawings.
- B. Stainless-Steel Corner and End Guards: Paper-covered, satin-finish, 0.0625-inch minimum, stainless-steel sheet corner guards; height as indicated. Provide 90-degree turn, unless otherwise indicated; and formed edges.
 - 1. Wing Size: 2-1/2 by 2-1/2 inches.
 - 2. Mounting Method: Double-faced, self-adhesive foam tape.
 - 3. Corner Radius: 1/8 inch.

2.5 IMPACT-RESISTANT WALL COVERINGS

- A. Semirigid Sheet Wall Covering: Semirigid, embossed, fiber-backed, impact-resistant plastic sheets complying with fire-test-response characteristics specified and are chemical and stain resistant. Provide manufacturer's standard; match moldings and trim as required. Model as indicated on the drawings.
 - 1. Sheet Size: As indicated.
 - 2. Sheet Thickness: 0.060 inch.

- B. Semirigid Vinyl Sheet Wall Covering: 100% pure homogenous vinyl, extruded, semi-rigid PVC sheet, contains no plasticizers or fillers. Model as indicated on the drawings.
 - 1. Sheet Size: As indicated.
 - 2. Sheet Thickness: 0.060 inch

2.6 FABRICATION

- A. Fabricate impact-resistant wall protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.
- B. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.
- C. Remove sharp or rough areas on exposed traffic surfaces.
- D. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnecting members to other construction.
- E. Provide inserts and other anchoring devices for connecting components to concrete or masonry. Fabricate anchoring devices to withstand imposed loads. Coordinate anchoring devices with the supporting structure.

2.7 FINISHES, GENERAL

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

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.
- C. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils. Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
 - 1. Color and Gloss: As indicated on the drawings

2.9 STAINLESS-STEEL FINISHES

- A. Bright, Directional Polish: No. 4 finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which impact-resistant wall protection system components and impact-resistant wall covering materials will be installed.
 - 1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Impact-Resistant Wall Covering Materials: Ensure wall surfaces to receive impact-resistant wall covering materials are dry and free from dirt, grease, loose paint, and scale.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Before installation, clean substrate to remove dust, debris, and loose particles.
- B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.
 - 1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- C. Install aluminum retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.
 - 1. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run.

3.3 CLEANING

- A. Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.
- B. Remove excess adhesive using methods and materials recommended by the manufacturer.
- C. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and dispose of legally.
- D. Leave installation areas in neat, clean condition.

END OF SECTION 10 26 00

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SECTION 10 44 00 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section "Common Product Requirements," submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. 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.
- E. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.
- F. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Size: 6-by-6-inch- square Samples.

1.2 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to Authorities Having Jurisdiction.
 - 1. Provide extinguishers listed and labeled by FM.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of Larsen's. Provided compliance with Project requirements, and prior approval by the Owner and the Architect of a properly documented substitution request, products by one of the following manufacturers...
 - 1. Amerex Corporation.
 - 2. Ansul Incorporated.
 - 3. Badger; Div. of Figgie Fire Protection Systems.
 - 4. J.L. Industries.
 - 5. Kidde.
 - 6. Potter-Roemer.

- B. Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in types, colors and finishes selected by Architect from manufacturer's standard, that comply with requirements of Authorities Having Jurisdiction.
 - 1. Multi-Purpose Dry Chemical, UL Rated 4A-80B:C, 10 lb. nominal capacity, in enameled steel container, for Class A, B, and C fires.
 - a. Larsen's "MP10."

2.2 FIRE-PROTECTION CABINETS

- A. Recessed Cabinet: To establish standards of manufacture, operation, performance, and appearance, Drawings and Specifications are based on products of Larsen's, Occult Series. Provided compliance with Project requirements, products of the following manufacturers will also be acceptable.
 - 1. J.L. Industries.
 - 2. Potter-Roemer.
- B. Nonrated Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 - 1. Provide cabinet 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 Mounting –Recessed:
 - 1. Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
- D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - 1. Trimless with hidden flange of same metal and finish as box that overlaps surrounding wall finish and that is concealed from view by an overlapping door.
- E. Door Material: Manufacturer's standard steel sheet.
- F. Door Style: Manufacturer's standard Solid design.
- G. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
 - 1. Provide minimum 1/2-inch- thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
- H. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

2.4 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
 - 1. Provide brackets for extinguishers not located in cabinets.
 - 2. Provide brackets for extinguishers located in cabinets.
- B. Identification: Provide lettering to comply with Authorities Having Jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

2. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
 - a. Lettering Color: Red.

2.5 FINISHES, GENERAL

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

2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets are to be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to Authorities Having Jurisdiction.
 1. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.
 2. Fasten cabinets to structure, square and plumb.
 3. Fasten mounting brackets to structure and cabinets, square and plumb.
- C. Apply decals on field-painted fire-protection cabinets after painting is complete.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors to operate freely. Verify that integral locking devices operate properly.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 44 00

SECTION 12 20 00 – WINDOW TREATMENT

PART 1 - GENERAL

1.1 SUBMITTALS

- A. In accordance with the requirements of Division 01 section “Common Product Requirements,” submit a complete listing of all manufacturers, products, model numbers, and designs proposed for use in the Work of this Section.
- B. Maintain all submittals at the Project Site for use during construction and for distribution to the Owner, through the Architect, upon completion of the Work.
- C. Submit only the items listed below to the Architect for review in accordance with Conditions of the Contract and Division 01 sections.
- D. Shop drawings for special components and application conditions that are not fully dimensioned or detailed in manufacturers' product data. Show relationships to adjoining work.
 - 1. Include typical elevation layout indicating proposed division between blind units and meeting edges at corners. Provide sections and details at head and sill between blind units and corners including inclined installations.
 - 2. Provide schedule of all units to be furnished, including field measurements at each location.
- E. Samples for initial selection of colors, in form of manufacturers' color charts consisting of sections of exposed components with integral or applied finishes showing full range of colors and materials.
- F. Samples for verification purposes, in full-size units of each component, material, and finish to be exposed to view, for each type of window treatment required. Prepare samples from same materials to be used for fabricating units.

1.2 QUALITY ASSURANCE

- A. Provide units produced by one manufacturer for each type required, with complete standard assemblies including hardware accessory items, mounting brackets, and fastenings.
- B. Furnish materials in colors and patterns selected by Architect from manufacturers' standard colors/patterns.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS

- A. Headrail: Channel-shaped section complete with tilting mechanism, top and end braces, top cradles, cord lock, and accessory items required for type of blind and installation.
- B. Bottom Rail: Tubular steel bottom rail, designed to withstand twisting or sagging. Contour top surface to match slat curvature, with flat or slightly curved bottom. Close ends with metal or plastic end caps of same color as rail. Finish rail in same color as slats.
- C. Slats: Spring-tempered aluminum (louver blades), rounded corners with forming burrs removed, as follows:
 - 1. Slat Width: 1-inch (25mm) nominal slats, with other components sized to suit.
 - a. Provide slats designed and spaced to achieve maximum overlap and closure for optimum light exclusion.
- D. Ladders: Designed to support and maintain slats at proper spacing and alignment in open and closed positions, as follows:
 - 1. Braided polyester cord design consisting of vertical components of not less than 0.043-inch nor more than 0.068-inch in diameter and integrally braided ladder rungs of not less than 4 threads; space ladders not further than 23 inches apart and 7 inches from ends of slats.

- E. Tilting Mechanism: Assembly including disengaging worm and gear mechanism to eliminate overdrive, low-friction gear tilter, drum and cradle at each ladder, tilt rod, tape clips, and grommet guides to prevent wear on ladder and cords; designed to hold slats at any angle and prevent movement of slats due to vibration, operated as follows:
 - 1. Wand Operator: Detachable clear plastic wand, of proper length to suit blind installation, detachable without tools by raising locking sleeve.
- F. Lifting Mechanism: Crashproof cord locks with cord separators and braided polyester or nylon lift cords with tassels at ends. Size cord to suit blind type. Include self-aligning cord equalizers designed to maintain horizontal blind position.
- G. Installation Brackets: Designed to facilitate removal of head channels. Provide intermediate brackets at spacing recommended by blind manufacturer. Include hardware necessary for secure attachment of brackets to adjoining construction and to headrails. Design brackets to support safely the weight of blind assemblies plus forces applied to operate blinds.
- H. Finish: Provide finishes indicated below. Finish exposed accessories and hardware to match rail color. Provide corrosion-resistant finish to concealed items of hardware.
 - 1. Steel Components: Galvanize and either phosphate coat or prime exposed steel surfaces. Finish with baked-on synthetic resin enamel finish.
 - 2. Aluminum Slats: Chemical conversion coat then follow with baked-on synthetic resin enamel finish coat.
- I. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 - 1. Hunter Douglas Contract.
 - 2. Levolor / Kirsch; a Newell Rubbermaid company.
 - 3. Mariak.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install window treatment units to comply with manufacturer's instructions. Position units level, plumb, secure, and at proper height and location relative to adjoining window units and other related work. Securely anchor units with clips, brackets, and anchorages suited to type of substrate.
- B. Provide clearance between sash and blinds to permit unencumbered operation of sash hardware.
- C. Isolate metal parts from concrete and mortar to prevent galvanic action. Use thick coating or other means recommended by manufacturer to effect separation.
- D. Protect installed units to ensure their being in operating condition, without damage, blemishes, or indication of use at substantial completion of project. Correct nonconforming damaged units. Replace units that cannot be field corrected.

END OF SECTION 12 20 00

SECTION 21 00 00 – BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Fire Protection Requirements specifically applicable to Division 21 sections, in addition to Division 01 - General Requirements.

1.2 RELATED DOCUMENTS

- A. Basic and supplemental requirements common to Fire Protection.
- B. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and Division 01 of the specifications apply to the work specified in this section.
- C. All work covered by this section of these specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

1.3 GENERAL

- A. The Contractor shall execute all work herein after specified or indicated on accompanying drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the drawings
- B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation
- C. The Fire Protection drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases, above suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Or where no ceilings exist. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted. All work shall be NFPA compliant and compliant with Insurance Underwriter requirements and guidelines.
- D. When the Fire Protection drawings do not give exact details as to the elevation of pipe the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping is generally intended to be installed true and square to the building construction, The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas, unless there is no ceiling.

1.4 DEFINITIONS

- A. These definitions are included to clarify the direction and intention of these Specifications. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated Owner's representative.
 - 1. Concealed / Exposed: Concealed areas are those that cannot be seen by the building occupants. Exposed areas are all areas that are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.
 - 2. General Requirements: The provisions of requirements of other Division 01 sections apply to entire work of contract and, where so indicated, to other elements that are included in project. Basic contract definitions are included in the General Conditions.

3. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.
4. Directed, requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect/Engineer," "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
5. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
6. As required: Where "as required" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
7. Furnish: The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."
8. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
9. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use".

1.5 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

- A. General: Refer to Division 01 for construction phasing and time increments.
- B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. If city or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.
- C. All work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to city controlled services. If inspections by city personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
- D. Compliance: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

1.6 CONTRACT DRAWINGS

- A. All dimensional information related to new structures shall be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- B. The interrelation of the specifications, the drawings, and the schedules are as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following the contractually prescribed information flow requirements.
- C. Should the drawings or specifications conflict within themselves, or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished.

1.7 FUTURE WORK

- A. Provide for future work under requirements of Section 01 11 00.
- ~~B. Project is designed for future expansion of [] system [as specified] [and] [as indicated].~~

1.8 ALLOWANCES

- A. Cash Allowance: Refer to Division 01 of the Construction Documents for information and requirements.

1.9 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner Contractor Agreement.
- ~~B. -Coordinate related work and modify surrounding work as required.~~
- C. Schedule of Alternates: See "Special Conditions" and Bid Form.
- D. Any Alternate Proposals are summarized in Division 01 of the specifications. The Contractor is directed to refer to all sections of the specifications and drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.10 SUBMITTALS

- A. Refer to Division 1, UGC, and supplemental UGCs for specification requirements pertaining to timeliness of submission and review, quantity, and format. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
- B. Proposed Products List: Include Products specified in the following sections:
 - 1. Section 21 05 29 – Fire Protection Supports and Sleeves
 - 2. Section 21 05 53 – Fire Protection Piping and Equipment Identification
 - 3. Section 21 13 13 – Fire Protection Systems
 - 4. Section 21 30 00 -- Fire Pumps
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories clearly marked and/or highlighted, with non-applicable information or data clearly noted in a single submittal.
- D. Mark dimensions and values in units to match those specified.
- ~~E. Submit fabrication drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment, (3) where called for elsewhere in these specifications; and (4) where specifically requested by the Architect/Engineer. Fabrication drawings shall be made at no additional charge to the Owner or the Architect/Engineer.~~

- F. Contractor shall submit a copy of the specifications with each submittal, marking compliance or deviation next to each paragraph. If a deviation is taken, contractor must provide written explanation as to what the deviation is and why it had to be taken. If a submittal does not contain the marked copy of the specifications, it is grounds for a rejected submittal without product review.
- G. All submittals that are re-submittals shall include written responses to all previous review comments. Failure to provide written responses will result in the submittal being rejected without product review.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General: Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment that will be submitted for incorporation into the project. The list shall be arranged in accordance with the organization of the specifications. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval. The initial list shall be submitted as herein specified. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these specifications have been met and samples shall be furnished when requested. All manufacturers' data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
- C. It is not the intent of the drawings and/or specifications to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- D. The specified products have been used in preparing the drawings and specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the Architect/Engineer is final.
- E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- F. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- G. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
- H. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

- I. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the specifications.
- J. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- K. Materials and Equipment Lists: Eight (8) copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer. The lists shall be accompanied by eight (8) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the shop drawings.
- L. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.12 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site but shall be replaced with new materials and/or equipment.
- B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.13 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.14 REGULATORY REQUIREMENTS

- A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications. All referenced codes and standards shall be those current at the date of issue of the design documents.
- B. National Fire Protection Association Standards (NFPA)
 - 1. NFPA No. 13, Sprinkler System, Installation
 - 2. NFPA No. 14, Standpipes and Hose Systems
 - 3. NFPA No. 20, Centrifugal Fire Pumps
 - 4. NFPA No. 37, Stationary Combustion Engines & Gas Turbines
 - 5. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
 - 6. NFPA No. 70, National Electrical Code
 - 7. NFPA No. 72D, Proprietary Signaling Systems
 - 8. NFPA No. 88A, Standard for Parking Structures
 - 9. NFPA No. 99, Health Care Facilities
 - 10. NFPA No. 101, Life Safety Code
- C. American National Standards Institute (ANSI)
- D. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards

- E. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
- F. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.
- G. City of [*];Houston Fire Department as may be applicable to construction on this site.
- H. Texas Occupational Safety Act: All applicable safety standards.
- I. Occupational Safety and Health Act (OSHA).
- J. ADA and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards and the requirements of the American Disabilities Act.
- K. Refer to specification sections hereinafter bound for additional Codes and Standards.
- L. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. In all cases where Underwriters Laboratories, Inc. has established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- M. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 01 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations

1.15 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.

- E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8" on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item. Where steel is specified to be hot dip galvanized, mill galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
- G. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.16 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other sections. Obtain permission of [Owner] [Architect/Engineer] before proceeding.

1.17 MANUFACTURER'S RECOMMENDATIONS

- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, testing and piping of all equipment and material. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturer's directions, and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.18 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of Fire Protection equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.19 LARGE APPARATUS

- A. Any large piece of apparatus that is to be installed in any space in the building, and that is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.20 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

1.21 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.22 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

- A. The Contractor shall note that the electrical design and drawings are based on the equipment scheduled and indicated on the drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- B. The electrical trades shall provide all interconnecting wiring for the installation of all power. The electrical trades shall provide all disconnect switches as required for proper operation, as indicated on the drawings or required by applicable code. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division -21.
- C. Provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review within thirty (30) days after the submittals for equipment have been reviewed. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control drawings, not a series of manufacturer's individual diagrams. After these diagrams have been reviewed by the Architect/Engineer, copies shall be transmitted to the electrical trades by the Contractor.

1.23 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)
- B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the drawings, the matter shall be referred to the A/E for ruling.

1.24 SITE OBSERVATION

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.25 INSTALLATION METHODS

- A. Where to Conceal: All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings below concrete beams or other deep projections, pipe shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration.
- E. All pipe shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All pipes run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
 - 1. All piping not directly buried in the ground shall be considered as "interior piping."
 - 2. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above ceiling area about to be "sealed" off. The Contractor shall give as much advance notice as possible no less than 5 working days or as agreed by the Project Manager.
 - 3. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All mechanical and electrical work at and above the ceiling, including items supported by the ceiling grid shall be complete and installed in accordance with contract requirements, including power to other powered items. Adequate lighting shall be provided to permit thorough inspection of all above ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Architect/Engineer, Physical Plant, Resident Construction Manager's Construction Inspector(s), the Resident Construction Manager, and Office of Facilities Planning and Construction (OFPC). Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
 - 4. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - 5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

1.26 RECORDS FOR OWNER

- A. The Contractor shall maintain a set of "blueprint" prints in the Field Office for the sole purpose of recording "installed" conditions. Daily note all changes made in these drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.

- B. At contract completion, the Contractor shall provide an electronic file of the revised drawings. The contractor shall transfer the information from the "blueprint" prints maintained as described above, and turn over this neatly marked set of reproducible drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these specifications, and to the Uniform General Conditions, for additional information. These drawings shall include as a minimum:
1. Addendum written drawing changes.
 2. Addendum supplementary drawings.
 3. Accurate, dimensioned locations of all underground utilities, services and systems.
 4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 5. Change Order written drawing changes.
 6. Change Order supplementary drawings.
- C. Electronic Media
1. The contractor shall submit three compact discs containing all the drawings in AUTOCAD 12 or 14 format.
- D. "As installed" plans shall bear a stamp, "stick-on decal" or lettered title block generally located in lower right hand corner of drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.
- E. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in duplicate, prepared in a neat brochure or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.
1. All warranties and guarantees and manufacturers' directions on equipment and material covered by the Contract.
 2. Two sets of operating instructions for heating and cooling and other mechanical and electrical systems. Operating instructions shall also include recommended preventative maintenance and seasonal changeover procedures.
 3. Valve tag charts and diagrams specified herein.
 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 5. Copies of approved shop drawings.
 6. Any and all other data and/or drawings required as submittals during construction.
 7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.
- 1.27 CUTTING AND PATCHING
- A. General: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes shall be core drilled to exact size.
- C. Restoration: All openings shall be restored to "as new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.
- E. Plaster: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. Special Note: No cutting, boring, or excavating that will weaken the structure shall be undertaken.

~~1.28 ROOF PENETRATIONS AND FLASHING~~

~~A. Pipe, sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided and installed by a qualified contractor for all roof penetrations. This shall be the responsibility of the General Contractor.~~

~~1.29 EXCAVATION, TRENCHING AND BACKFILL~~

~~A. Excavation (See Divisions 00 and 01 for special requirements related to excavation and trenching.):~~

- ~~1. The subcontractors shall perform all excavations of every description, for their particular installations and of whatever substances encountered, to the depths indicated on the drawings and/or required for the installation of piping. All exterior lines shall be installed with a minimum cover of 24," unless otherwise indicated. Generally, more cover shall be provided if grade will permit. All excavation materials not required for backfill or fill shall be removed and wasted as acceptable to the Construction Inspector. All excavations shall be made only by open cut. The banks of trenches shall be kept as nearly vertical as possible and where required, shall be properly sheeted and braced. Trenches shall be not less than 12" wider nor more than 16" wider than the outside edges of the pipe to be laid therein, and shall be excavated true to line so that a clear space not less than 6" nor more than 8" in width is provided on each side of the pipe.~~
- ~~2. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the pipe on undisturbed soil or 2" of sand fill at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes shall be dug after the trench bottom has been graded. Where inverts are not shown, grading shall be determined by the National Plumbing Code for the service intended and the size used. Bell holes for pipe joints shall be 12" in depth below the trench bottom and shall extend from a point 6" back of the face of the bell. Such bell holes shall be of sufficient width to provide ample room to complete the pipe joint. Bell holes for sewer tile and water pipe shall be excavated only to an extent sufficient to permit accurate work in the making of the joints and to insure that the pipe, for a maximum of its length, will rest upon the prepared bottom of the trench. Depressions for joints other than bell and spigot shall be made in accordance with the recommendations of the joint manufacturer for the particular type of joint used. Special pipe beds shall be provided as specified hereinafter.~~
- ~~3. The lower 4" of the pipe trenches measuring from an overhead line set parallel to the grade line of the sewer shall be excavated only a few feet in advance to the pipe laying, by workers especially skilled in this type of work. Where damage is likely to result from withdrawing sheeting, the sheeting shall be left in place. Except at locations where excavation of rock from the bottom of trenches is required, care shall be taken not to excavate below the depths required. Where rock excavation is required, the rock shall be excavated to a minimum over depth of 6" below the trench depths specified. The over depth rock excavation and all excess trench excavation shall be backfilled with sand. Whenever wet or otherwise unstable soil is incapable of properly supporting the pipe is encountered in the trench bottom, such soil shall be removed to a depth and for the trench lengths required, and then backfilled to trench bottom grade, as hereinafter specified, with sand.~~
- ~~4. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the job site as directed by the Construction Inspector.~~
- ~~5. All shoring and sheeting required to perform and protect the excavations and to safeguard employees and/or adjacent structures shall be provided.~~
- ~~6. Excavate as required under the building in order that all piping etc., shall clear the ground a minimum of 12" for a distance of 24" on either side. Edges of such excavations shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Construction Inspector. The bottom of such excavation shall be graded to drain in a manner acceptable to the Construction Inspector.~~

- ~~7. Trenches for water lines inside the building shall be properly excavated, following, in general, the procedures set out for exterior lines. Where floors are to be poured over these lines, they shall be backfilled, tamped and settled with water. Where no flooring is to cover the lines, they shall be backfilled to form a level grade.~~
- ~~8. All surplus materials removed in these trenching operations becomes the property of the contractor, and shall be disposed of at the expense of the contractor, at a legal disposal site, off of the campus.~~

~~B. Backfilling~~

- ~~1. Trenches shall not be backfilled until all required tests are performed and until the piping, utilities systems, etc., as installed are certified by the Owner's inspector to conform to the requirements specified hereinafter. The trenches shall be carefully backfilled with sand to a depth of 12 inches above the top of the pipe. The next layer and subsequent layers of backfill may be excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from large clods of earth or stones larger than 1 1/2" in diameter, flooded until the pipe has cover of not less than one foot. The remainder of the backfill material shall then be thrown into the trenches, moistened, and tamped or flooded in one-foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and mounded over, and smoothed off.~~
- ~~2. Backfill under concrete slabs on fill shall be as specified above, shall be gravel, or shall be other such materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.~~

~~C. Opening and Re-closing Pavement and Lawns: Where excavation requires the opening of existing walks, streets, drives, other existing pavement, or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched, using materials to match those cut out. The patches shall thoroughly bond with the original surfaces and shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas.~~

~~D. Excavation in Vicinity of Trees: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5 ft. to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb radius shall be brought to the attention of the Construction Inspector before they are cut or damaged in any way. The Construction Inspector will give immediate instructions for the disposition of it. All stumps and roots encountered in the excavation, which are not within the outermost limb radius of existing trees, shall be cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped.~~

4.301.28 OPERATION PRIOR TO COMPLETION

- A. When any piece of Fire Protection equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Project Manager's written permission to do so. The warranty period shall, however, not commence until the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust and complete all deficiency list items prior to being started, commissioned and before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

4.311.29 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workers, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of the fire protection system for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall them upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, and piping.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, coordination meetings shall be included in the contract amount.

4.321.30 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

4.331.31 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Check inspections shall include fire sprinkler piping, equipment, overall fire protection system controls, and such other items hereinafter specified or specifically designated by the Architect/Engineer.

4.341.32 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

4.351.33 CLEANING AND PAINTING

- A. All equipment and piping, etc., furnished and installed in exposed areas under Division 21 of these specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 21 work.
- B. All purchased equipment shall be delivered to the job with a suitable factory protective finish with the colors hereinafter specified. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
- C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metalwork shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- D. Color of finish painting shall be painted in accordance with The University of Texas Standard Color Schedule for machinery spaces using Pratt and Lambert, Inc.'s "Effector" enamel, or approved equal. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

ITEM	COLOR	"P and L" PAINT NUMBER
Fire Protection Equipment and Piping	Safety Red	R131R (Vibrant Red)

- E. Jacketing on insulation shall not be painted.
- F. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.
- G. Scope of painting for Division 21--work in areas other than those defined as "exposed" is as follows:
 1. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers in underfloor spaces shall be cleaned and painted with two coats of Tropical Paint Co. No. 77-black asphaltic emulsion. Galvanized steel and copper lines in these spaces shall not be painted.
 2. All canvas finishes including those underfloor and in concealed spaces shall be painted with one sizing coat if not already sized, containing mildew resistant additive and Arabol adhesive prior to any other specified finish paint.
 3. All fire protection piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA.
 4. If insulated, the piping shall be primed, only, prior to insulation, and the insulation jacketing shall be painted as specified for piping. The requirements of this paragraph are "primary" and have priority over any conflicting specification or instruction, should a conflict in the Construction Documents exist.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.
- C. Responsibility for furnishing proper equipment and/or material and ensuring that equipment and/or material is installed as intended by the manufacturer, rests entirely upon the Contractor. Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.
- D. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.
- E. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be by a non-domestic manufacturer provided they fully comply with Contract Documents.
- F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.2 NAMEPLATES

- A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
- B. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters.
- C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.
- D. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.
 - 1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.3 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.
- B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.
- C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.
- D. Plates will not be required for piping where pipe sleeves extend 3/4-inch or more above finished floor.

~~2.4 ROOF PENETRATIONS AND FLASHING~~

- ~~A. Pipe sleeves, pitch pockets and flashings compatible with the roofing installation shall be provided and installed for all roof penetrations by a contractor qualified in such Work. Installation shall comply with the Contract Documents and with FM General Data Sheets 1-28, 1-29, 1-31 & 1-49 along with the FM approval guide.~~

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.
- B. The size of equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine that the equipment proposed will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- D. Space Requirements:
1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
 2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.
- E. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

3.2 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations, as shown on the drawings and stated in the specifications.
- C. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible.
- D. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
- E. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days prior to the inspection.
- F. Precedence of Materials:
1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.

2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":
 - a. Building lines
 - b. Structural members
 - c. Structural support frames supporting ceiling equipment
 - d. Electric tracked vehicle system
 - e. Pneumatic trash and linen system
 - f. Pneumatic tube system
 - g. Soil and drain piping
 - h. Vent piping
 - i. Supply, return and outside air ductwork
 - j. Exhaust ductwork
 - k. HVAC water and steam piping
 - l. Condensate piping
 - m. Fire protection piping
 - n. Natural gas piping
 - o. Medical/Laboratory gases
 - p. Domestic water (cold and hot, softened, treated)
 - q. Refrigerant piping
 - r. Electrical conduit
3. Coordinate fire protection system with other trade systems as required to maintain system right-of-ways.

3.3 TESTING

- A. When any piece of equipment is operable and it is to the advantage of the Contractor to operate the equipment, Contractor may do so, provided that Contractor properly supervises the operation, and has the Project Manager's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of Substantial Completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean and properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.
- C. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.
- D. Notify the Project Manager and the Architect/Engineer in writing at least five (5) calendar days or as agreed by the Project Manager prior to each test and prior to other Specification requirements requiring Owner and Architect/Engineer to observe and/or approve tests.
- E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.
- F. Maintain Log of Tests as hereinafter specified.
- G. See specifications hereinafter for additional tests and requirements.
- H. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.4 TRAINING

- A. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."

- B. Specific training and operating instructions for individual equipment components shall be as specified in the individual Specification Sections.

END OF SECTION 21 00 00

SECTION 21 05 29 – FIRE PROTECTION SUPPORTS AND SLEEVES

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 21 00 00 – Basic Fire Protection Requirements
- B. Section 21 05 53 – Fire Protection Piping and Equipment Identification

1.2 SECTION INCLUDES

- A. Pipe and equipment hanger and supports
- B. Equipment bases and supports
- C. Sleeves and seals
- D. Flashing and sealing equipment and pipe stacks

1.3 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete: Equipment bases
- B. Section 07 84 00 – Firestopping: Joint seals for piping penetration of fire rated assemblies
- C. Section 09 91 00 – Painting
- D. Section 21 13 13 – Fire Protection Systems
- E. Section 21 30 00 – Fire Pumps

1.4 REFERENCES

- A. ASME B31.1 – Power Piping
- B. ASME B31.9 – Building Services Piping
- C. ASTM F708 – Design and Installation of Rigid Pipe Hangers
- D. MSS SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer
- E. MSS SP69 – Pipe Hangers and Supports – Selection and Application
- F. MSS SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices
- G. NFPA 13 – Installation of Sprinkler Systems
- H. NFPA 14 – Installation of Standpipe and Hose Systems
- I. UL 203 – Pipe Hanger Equipment for Fire Protection Service

1.5 SUBMITTALS

- A. Submit under provisions of Section 21 00 00.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.6 REGULATORY REQUIREMENTS

- A. Supports for Sprinkler Piping: Shall be in conformance with NFPA 13.
- B. Supports for Standpipes: Shall be in conformance with NFPA 14.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and Supports:
1. Anvil International.
 2. Kinder.
 3. Cooper B-Line.
 4. Power Strut.
 5. Unistrut
- B. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping. Shop Drawings shall be provided, indicating locations and details of anchors, supports, joints, hangers, etc. The hanger design shall conform to the ASME Code for Pressure Piping.
- C. All auxiliary steel required for supports, anchors, guides, etc. shall be provided unless specifically indicated to be provided by others.
- D. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
- E. All Supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- F. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.
- G. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.
- H. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- I. Hangers supporting and contacting brass or copper lines 3" in size and smaller shall be Anvil Fig. CT-99c, adjustable, copper plated, tubing ring. Hangers supporting and contacting brass or copper lines 4" and larger shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. For insulated copper or brass domestic water lines, hangers for all sizes of pipe shall be Anvil Fig. 300, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. Isolate all copper or brass lines from all ferrous materials with approved dielectric materials. Hangers supporting and contacting ferrous lines larger than 6" in size and outside of insulation on lines with the outside diameter equivalent to 10" diameter pipe shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.
- J. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the owner.
- K. Supports for vertical piping in concealed areas shall be double bolt riser clamps, Anvil Fig. 261, or other approved equal, with each end having equal bearing on the building structure, and located at each floor. Two-hole rigid pipe clamps at 4 ft. o.c. or steel framing channels and Anvil Fig. 261 riser clamps may be used to support pipe directly from vertical surfaces or members where lines are not subject to expansion and contraction. Where brass or copper lines are supported on trapeze hangers or steel framing channels, the pipes shall be isolated from these supports with plastic tape with insulating qualities, or strut clamps. Supports for vertical piping in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the building structure above the top of the riser, and the underside of the penetrated structure. The Contractor shall use a drilled anchor as specified above, and use a Anvil No. 595 Socket Clamp with Anvil No. 594 Socket Clamp Washers, as a riser clamp. The top riser hanger shall consist of two (2) hanger rods (sized as specified) anchored to the underside of the building structure, supporting the pipe by means of the material specified. Risers penetrating floors shall be supported from the underside of the penetrated floor as specified for the top of the riser.

- L. Pipe Supports in Chases and Partitions: Horizontal and vertical piping in chases and partitions shall be supported by hangers or other suitable support. Pipes serving equipment shall be securely supported near the point where pipes penetrate the finish wall. Supports shall be steel plate, angles, or special channels such as Unistrut mounted in vertical or horizontal position. Pipe clamps such as Unistrut P2426, P2008, P1109 or other approved clamps shall be attached to supports. Supports shall be attached to wall or floor construction with clip angles, brackets, or other approved method. Supports may be attached to cast iron pipe with pipe clamp, or other approved method. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action.
- M. All electrical conduits shall be run parallel or perpendicular to adjacent building lines. Single conduits running horizontally shall be supported by "Caddy" or "Minerallac" type hangers from adequately sized rods (minimum 1/4") from the building structure. Where multiple conduits are run horizontally, they shall be supported on trapeze of "Unistrut" type channel suspended on rods or bolted to vertical building members. Conduit shall be secured to channel with galvanized "Unistrut" type conduit clamps or stainless steel "Unistrut" type "Uni-Clips." All hangers shall be fastened to the building structure in the same manner as specified above for pipe hangers. Spacing of hangers shall be adequate for the weight and rigidity of the conduits involved; in any case, no greater than 8' centers. Where feasible, conduits may be fastened to the concrete by one-hole straps thoroughly anchored to the concrete in an approved manner. Flexible conduit shall also be supported in an acceptable manner so as not to interfere with the maintenance of above-ceiling equipment, and to support it from touching the ceiling system. Conduit shall be located so as not to inhibit removal of ceiling tiles.
- N. Vertical conduits shall be supported as often as necessary for rigidity by clamps resting on adjacent beams or floor slabs, using a minimum of one support per floor.
- O. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- P. Vibration Isolation: Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc.). Piping that may vibrate and create an audible noise shall also be isolated.
- Q. Attachment:
1. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
 2. Inserts shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
 3. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
 4. Hangers shall be attached to the structure as follows:
 - a. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - b. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 - c. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.

- d. Pre-Cast Tee Structural Concrete: Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod. Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees."
 - e. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 - f. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
- R. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Cooper BLine, Uni-Strut, Power Strut, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- S. Finishes: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, and brackets, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. Universal concrete inserts shall be cadmium plated.
- T. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.
- U. All hangers and supports for fire standpipe systems and fire sprinkler systems shall be Factory Mutual and Underwriters Laboratories, Inc. listed and labeled. Construction of hangers shall be as described above for common piping, except for the above-mentioned requirements.

2.2 ACCESSORIES

- A. Hanger Rods: Galvanized mild steel threaded both ends, galvanized threaded one end, or galvanized continuous threaded.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.

2.3 WALL, FLOOR AND CEILING PLATES:

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. All equipment rooms are classified as finished areas. Floor penetrations in exposed (except in stair wells) areas shall be finished using 'bell' fitting to fit pipe or insulation and sleeve and shall be painted to match the pipe. Penetrations in stairwells shall have flat floor plate painted to match pipe.

2.4 SLEEVES

- A. General: All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, etc., shall be sleeved. All penetrations must pass through sleeves. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing vertical solid concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
 - 1. Sleeve material for floors and exterior walls shall be Schedule 40 galvanized steel with welded water stop rings.
 - 2. Sleeves through interior walls to be galvanized sheetmetal with gauge as required by wall fire rating, 20 gauge minimum.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4", except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc., plus any specified insulation. Void between sleeve and pipe in interior penetrations shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.
- C. Floor sleeves shall extend above the finished floor as detailed on the drawings, except that floor sleeves in stairwells shall be flush with the finished floor. Sleeves in walls shall be trimmed flush with wall surface. Refer to the details on the project drawings. Where the details differ from these specifications, the drawings take precedence.
- D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Vermin proofing: The open space around all piping, etc., passing through the ground floor and/or exterior walls shall be vermin proofed in a manner acceptable to the Architect/Engineer.
- F. Waterproofing: The annular space between a pipe and its sleeve in interior floors shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of floor.
- G. Air Plenums: The space around piping, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- H. Fireproofing: Seal all pipe, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below, that will form a watertight, vermin tight barrier that is capable of containing smoke and fire up to 2000° F for two hours. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed, but shall be corrosion protected with galvanized plating. Repair any damaged galvanized plating with a coating of 'Galvalum'.
- L. Hanger Rods: (NOTE: All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the contractor shall take appropriate measures to protect the pipe or other materials from damage.)

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors (except in stairwells) two inches above finished floor level. Sleeves through floors shall have welded waterstop rings. Sleeves shall be sealed watertight to floors and pipe.
- D. Where piping penetrates floor, ceiling, or wall, close space between pipe and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.
- E. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.6 PIPE SUPPORT SCHEDULE

STEEL PIPE SIZE <u>Inches</u>	MAX. HANGER SPACING <u>Feet</u>	HANGER ROD DIAMETER <u>Inches</u>
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8

END OF SECTION 21 05 29

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SECTION 21 05 53 – FIRE PROTECTION PIPING AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 21 00 00 – Basic Fire Protection Requirements.
- B. Section 21 05 29 – Fire Protection Supports and Sleeves.

1.2 SECTION INCLUDES

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

1.3 RELATED SECTIONS

- A. Section 09 91 00 – Painting: Identification painting.

1.4 REFERENCES

- A. ASME A13.1 – Scheme for the Identification of Piping Systems.

1.5 SUBMITTALS

- A. Submit under provisions of Section 21 00 00.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit two of each type of label, tag, etc., of the approximate size specified or implied in the specification.
- F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 21 00 00.
- B. Record actual locations of tagged valves.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 MANUFACTURERS

- A. Equipment Tags, Valve Tags, and Markers:
 - 1. Marking Systems, Inc.
 - 2. Seton Name Plate Company.
 - 3. W.H. Brady Company.
 - 4. Graphic Products, Inc.

2.3 EQUIPMENT

- A. Description: 3" x 4" vinyl label, 3.0 Mil self-adhesive vinyl similar to DuraLabel Pro. Label color shall be black text on a white background. The label shall contain the following information per the template, described in Attachment "B":
 1. Asset Short Description As listed in Equipment Matrix.
 2. Asset Number: As listed in Equipment Matrix.
 3. Asset Location: As listed in Equipment Matrix.
 4. Asset Bar Code Number.
- B. All scheduled equipment shall be identified with an Equipment Tag.

2.4 VALVE TAGS

- A. Valve tags shall conform to ANSI A13.1-1981 "Scheme for the Identification of Piping Systems", refer to Attachment "A" for abbreviation, and label color designations.
- B. Valve tags shall be black ABS plastic tags: Injected molded ABS plastic, 3.375" X 4.75" with self-adhesive vinyl label, similar to DuraLabel Pro, affixed to valve tag. Each tag shall be attached to its valve with one tie strap.
- C. Vinyl Label: 3.0 Mil self-adhesive vinyl similar to DuraLabel Pro. Label color shall be as per the standard designated colors listed in the attachment to this specification. The label shall contain the following information as per template, refer to Attachment "B":
 1. Asset Short Description: As listed in Equipment Matrix.
 2. Asset Number: As listed in Equipment Matrix.
 3. Asset Location: As listed in Equipment Matrix. .
 4. Asset Bar Code Number.
- D. Each valve shall be named as per attached valve tag naming convention, refer to Attachment "C".
- E. In addition to valve tags, valves at PRV stations, and other valves as specified shall be tagged with standardized color coded plastic tags. Each tag shall be attached to its valve with one tie strap. These tags shall be 2-½ inches wide by 1-½ inches high with these color codings:
 1. Red = normally closed.
 2. Green = normally open.
 3. Blue = open in winter, closed in summer.
 4. Yellow = closed in winter, open in summer.
- F. Valve Tag Fasteners: Single ABS plastic tie strap.

2.5 PIPE MARKERS

- A. Pipe Markers shall conform to ANSI A13.1-2007 "Scheme for the Identification of Piping Systems" as indicated below.

Pipe Contents	Label Abbreviation	Label Colors (Background/Text)
Fire Suppression Water	FIRE	Red/White
Dry Pipe Sprinklers	DRY FIRE	Red/White
Pre-action Sprinklers	PREACTION	Red/White
Wet Sprinklers	WET FIRE	Red/White

- B. Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Heat sealed or heat shrink, spring fasteners, clips or snap-on are acceptable.

- E. Underground Plastic Pipe markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- F. Pipe markers and arrow markers also shall be provided for all piping systems.
- G. Use Seton Setmark Type SNA or Brady snap-on type identification for all piping systems, up through 6 inch. For piping systems larger than 6 inches, use Seton or Brady strap-on markers or similar by Marking Services, Inc.

2.6 CEILING GRID TAG FOR EQUIPMENT LOCATED ABOVE LAY-IN CEILING

- A. Description: 3/4" x variable length" vinyl label, 3.0 Mil self-adhesive vinyl similar to Dura Label Pro. Label color shall be black text on a white background. The label shall contain the following information per the template, described in Attachment "C":
 - 1. Asset Short Description: As listed in Equipment Matrix.
 - 2. Asset Bar Code Number.
- B. All scheduled equipment above finish lay-in ceiling shall be identified with an Equipment Tag.
- C. All ceiling grid tags shall be installed prior to the ceiling cover inspection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Install plastic tape, and pipe markers completely around pipe in accordance with manufacturer's instructions.
- D. Locate markers on the two (2) lower quarters of the pipe where view is unobstructed.

3.2 VALVE TAGS

- A. Contractor(s) shall provide and install valve tags on all valves installed within this Project, except check valves; Existing valve tags shall not be attached to new valves. When removing and/or replacing existing tagged valves, give the Owner all existing tags that are attached to the valves that are removed. New tags with new asset numbers shall be provided for new valves.

3.3 APPLICATION OF MARKERS AND STENCILS

- A. Piping runs throughout the Project including those above lift-out ceilings, under floor and those exposed to view when access doors or access panels are opened shall be identified by means of pipe markers and/or stencils. Concealed areas, for purposes of this identification section, are those areas that cannot be seen except by demolition of the building elements. In addition to pipe markers and/or stencils, arrow markers shall be used to indicate direction of flow.
- B. As a minimum, locate pipe markers and/or stencils as follows:
 - 1. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one (1) header, it is necessary to mark only the header.
 - 2. Every 20 feet in exposed and concealed areas on all piping systems. Provide at least one (1) pipe marker in each room on all piping systems.
 - 3. At each branch or riser take off on piping systems, excluding short takeoffs for fixtures.
 - 4. Provide a pipe marker or stencil and an arrow marker at every point of pipe entry or exit where the pipe penetrates a wall, floor, service column or enclosure.
 - a. At access doors, manholes and similar access points that permit view of concealed piping.
 - b. Near major equipment items and other points of origination and termination.
- C. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.

- D. Provide a double-ended arrow marker when flow can be in either or both directions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Tag automatic controls, instruments and relays. Key to control schematic.
- I. Provide ceiling grid tags to locate valves or other concealed equipment above T-bar type panel ceilings. Locate in corner of grid closest to equipment.
- J. Identify right and left nipple and coupling union assemblies with the statement "Right/Left Nipple/Coupling".

END OF SECTION 21 05 53

SECTION 21 13 13 – FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 21 00 00 – Basic Fire Protection Requirements
 - B. Section 21 05 29 – Fire Protection Supports and Sleeves
 - C. Section 21 05 53 – Fire Protection Piping and Equipment Identification
- 1.2 SECTION INCLUDES
- A. Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.
- 1.3 RELATED SECTIONS
- A. Section 31 23 16.13 – Trenching
 - B. Section 09 91 00 - Painting
 - C. Section 21 05 13 – Fire Protection Motors
 - D. Section 21 30 00 - Fire Pumps
 - E. Section 22 20 00 – Plumbing, Piping, Valves and Fittings
- 1.4 REFERENCES
- A. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
 - C. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
 - D. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - E. ANSI/ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.
 - F. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded.
 - G. ANSI/ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
 - H. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - I. ANSI/ASME B16.25 - Buttwelding Ends.
 - J. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
 - K. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
 - L. ANSI/ASTM A135 - Electric-Resistance-Welded Steel Pipe.
 - M. ANSI/ASTM A47 - Malleable Iron Castings.
 - N. ANSI/ASTM B32 - Solder Metal.
 - O. ANSI/AWS A5.8 - Brazing Filler Metal.
 - P. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings.
 - Q. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast.
 - R. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
 - S. ASTM A120 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated (Galvanized) Welded and Seamless, for Ordinary Uses.

- T. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - U. ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - V. ASTM B75 - Seamless Copper Tube.
 - W. ASTM B88 - Seamless Copper Water Tube.
 - X. ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 - Y. ASTM F442 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
 - Z. AWS D10.9 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
 - AA. NFPA 13 - Installation of Sprinkler Systems.
 - BB. NFPA 14 - Standpipe and Hose Systems.
 - CC. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances
 - DD. UL - Fire Protection Equipment Directory.
 - EE. City of Texas, Fire Department Standards.
 - FF. State of Texas, State Fire Marshal Rules.
 - GG. All hose threads, coupling types, etc., utilized in the fire protection systems shall conform to the standards and requirements of the City of * , Texas Fire Department.
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 21 00 00.
 - B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
 - C. Product Data: Provide data on sprinkler heads, valves, and specialties, including manufacturer's catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections.
 - D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds requirements specified, and suggested by listed codes.
 - E. Provide certificate of compliance from authority have jurisdiction indicating approval of field acceptance tests.
- 1.6 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 21 00 00.
 - B. Maintenance Instructions: Include installation instructions, spare parts lists, procedures, and treatment programs.
- 1.7 QUALITY ASSURANCE
- A. Sprinkler Systems: Perform work to NFPA 13.
 - B. Standpipe and Hose Systems: Perform to NFPA 14.
 - C. Welding Materials and Procedures: Perform to ASME Code.
 - D. Equipment and Components: Bear FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
 - E. Maintain one copy of each document on site.

- F. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas. All design submittal documents and shop drawings shall bear the responsible engineers signed and dated seal.
 - G. All parts of fire protection piping systems shall conform to all provisions of Underwriters' Laboratories requirements. All equipment shall bear the Underwriters' Laboratories label of approval.
 - H. Determine volume and pressure of incoming water supply from residual pressure water flow test.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 21 00 00.
 - B. Deliver and store valves in shipping containers, with labeling in place.
 - C. Provide temporary protective coating on cast iron and steel valves.
 - D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.1 UNIONS:

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system. No unions will be required in welded lines. Unions 2 inch and smaller shall be Class 300 AAR threaded malleable iron unions with iron to brass seats, and 2 ½ inch and larger shall be ground flange unions. Companion flanges on lines at various items for equipment machines and pieces of apparatus shall serve as unions to permit removal of the particular items.

2.2 FLANGES:

- A. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Allthread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and rated at least ANSI Grade I.
- B. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.

2.3 FLANGE GASKETS

- A. Gaskets shall be placed between the flanges of all flanged joints.
- B. Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
- C. Spares - Contractor shall provide ten spares for every flange size and rating.

2.4 WALL, FLOOR AND CEILING PLATES:

- A. See Section 21 00 00.

2.5 SLEEVES, INSERTS, AND FASTENINGS:

- A. General: All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, etc., shall be sleeved. Refer to Specification Section 21 05 29.

2.6 MATERIALS:

A. PIPING:

1. All pipe used for fire protection standpipe systems and fire sprinkler systems shall be Schedule 40 black steel pipe conforming to ASTM A-795 or ASTM A-53. All piping 2 1/2" and larger shall be welded, unless otherwise indicated herein.
2. Use of piping, when approved by UT System, shall be "roll" grooved type; cut grooved pipe is not permitted.
3. No pipe smaller than 4" nominal pipe size shall be used for standpipe systems except for individual runouts to one hose cabinet. The 1-1/2" or 2-1/2" runout to cabinet shall have a maximum center line height of 60".
4. Scheduled 10 pipe is not permitted.

B. FITTINGS:

1. All welding type steel fittings employed in fabricating fire protection standpipe system and fire sprinkler systems shall conform to A.S.T.M. Specification A-234 and ANSI Standard B16.9-1964. All threaded fittings shall be Class 150 malleable iron fittings conforming to ASME B16.3. Grooved type fittings will not be accepted for use in standpipe systems unless specifically indicated. Pipe size changes shall be performed through the use of reducing tees or reducers designed for that purpose. The use of bushings is explicitly prohibited.
2. Unless otherwise shown or required, all fittings shall be welding type steel fittings. Refer to specification Section 22 20 00.
3. Threaded fittings shall be used when shown and shall be used from the point of connection of the pipe to the riser to each fire hose cabinet. Threaded fittings shall be Crane or Grinnell Company's Class 150 malleable iron fittings.
4. Grooved end couplings 2 1/2" and larger shall be Victaulic Style 07 "Zero-Flex" Rigid Coupling, with EPDM gasket (minimum 700 psi working pressure) for use with roll grooved piping. Products by Gustin-Bacon, Gruvlok are acceptable, or Engineer-approved equal. Reducing type couplings, outlet couplings, "T" outlet fittings, cut-in style fittings, snap joint couplings, and flange adapter type fittings are not acceptable. Provide grooved fittings similar to standard weld fittings.
5. Extra heavy "Thread-o-lets" shall be used at each point of departure from the riser to the fire hose or valve cabinet. A "Thread-o-let" shall be installed below the level of the valve in the cabinet and a minimum of two (2) threaded ells shall be used to provide a swing joint connection from the riser to the valve in the cabinet.

2.7 VALVES:

- A. General – All shutoff valves shall be UL listed and FM approved for fire protection service.

B. Shutoff valves for sizes 2 inch and smaller:

1. Two piece bronze ball valve, bubble-tight shutoff, full port, blow-out proof stem, chrome plated brass ball and silicon bronze stem, threaded end connections, conforming to MSS SP-110.
2. One piece, butterfly valve, full port, threaded ends, bronze housing and body, stainless steel disc. EPDM disc seal and slow closing.
3. All valves shall be furnished with two factory mounted internal supervisory switches.

C. Shut off valves for sizes over 2 inch:

1. Butterfly valves lug type with EPDM molded in seat liner, ductile iron disc, stainless steel stem, manual gear operator, conforms to MSS SP-67 and MSS SP-25, with integral supervisory switch. Where a grooved piping system is allowed grooved end type butterfly valves may be used, consisting of ductile iron body and disc EPDM seats, stainless steel stem. Valves shall be equipped with internal supervisory switch.

- 2. Gate valves – OS&Y (Outside Yoke and Stem) resilient wedge, epoxy coated interior and exterior, ASTM A 536 ductile iron valve body, bonnet and resilient wedge, ASTM B150 stem and flanged ends.
- D. Check valves for sizes 2 inch and smaller:
 - 1. Horizontal swing, bronze body, conforming to MSS Sp-80, threaded ends and rubber disc.
- E. Check valves for sizes over 2 inch:
 - 1. Iron body swing-check, bronze disc, seat ring and hinge pin, UL listed and FM approved, flanged ends, renewable seats and disc, tapped ¼ inch for ball drip assembly.

F. Standard of Quality for Fire Protection Valves:

<u>Size</u>	<u>Type</u>	<u>Class</u>	<u>Manufacturer</u>
2" and Smaller	Ball	300	Nibco No. KT-505-W-8, Stockham No. T-255-FB-P-UL
2" and Smaller	Butterfly	175	Milwaukee No. BB-SC02
2 ½" and Larger	Butterfly (lug)	250	Nibco No. LD3510-8
2 ½" and Larger	Butterfly (grooved)	300	Nibco No. GD-4765-8N
2" and Smaller	Check	200	Nibco No. KT-403-W
2 ½" and Larger	Check	175	Nibco No. F-908-W
2 ½" and Larger	Check (grooved)	250	Nibco No. G-917 W

2.8 SPRINKLER SYSTEM

A. SYSTEM DESCRIPTION

- 1. System to provide coverage for entire building.
- 2. Provide system to NFPA 13 [light hazard] [ordinary hazard, Group 1] [ordinary hazard, Group 2] [ordinary hazard, Group 3] [extra hazard] occupancy requirements unless otherwise noted. Refer to "FP" drawings for locations of design densities of specific rooms and areas.
- 3. Interface system with building fire and smoke alarm system.

B. SUBMITTALS

- 1. Submit under provisions of Section 21 00 00.
- 2. Preliminary Shop Drawings: Prior to detailed submission, submit preliminary layout of finished ceiling areas indicating only head locations coordinated with ceiling installation.
- 3. Shop Drawings: Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
- 4. Submit shop drawings, product data, and hydraulic calculations to Factory Mutual for review. Submit copies of all information, and review comments to Architect/Engineer and Owner.
- 5. Samples: Submit two of each style of sprinkler head specified.

C. PROJECT RECORD DOCUMENTS

- 1. Submit under provisions of Section 21 00 00.
- 2. Record actual locations of sprinkler heads and deviations of piping from drawings. Indicate drain and test locations.

D. OPERATION AND MAINTENANCE DATA

- 1. Submit under provisions of Section 21 00 00.
- 2. Maintenance Data: Include components of system, servicing requirements, Record Drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

E. QUALITY ASSURANCE

- 1. Perform Work in accordance with NFPA 13.
- 2. Equipment and Components: Bear FM label or marking.
- 3. Maintain one copy of all documents on site.

F. EXTRA MATERIALS

- 1. Furnish under provisions of Section 21 00 00.
- 2. Provide extra sprinkler heads as suggested under provisions of NFPA 13.
- 3. Provide suitable wrenches for each head type.

4. Provide metal storage cabinet in location designated.

G. PRODUCTS

1. General: The Contractor shall provide all components required for the complete installation of automatic sprinkler systems as hereinafter specified and indicated on the Drawings.
2. Qualifications of the Installer: The system shall be installed by a firm regularly engaged in the design and installation of automatic sprinkler systems in accordance with requirements of the National Fire Protection Association and Fire Protection and Engineering Bureau of Texas, or by an authorized agent of such firm. Evidence to support the above requirements may be required and any proposed installer who cannot show suitable experience will be rejected.
3. System Layout: The fire sprinkler areas, piping, head locations, etc. as indicated is only for Contractor's reference as to areas to be protected and possible piping routes. If header or manifold sizes are given in the drawings, then the sizes given shall be the minimum sizes installed. Actual number, spacing and location of heads, size and routes of piping shall be provided in accordance with the applicable Specifications and acceptable Shop Drawings. All layouts, head spacing, coverage, etc., as may be required by the referenced authorities and/or Architectural and Structural conditions shall be made without increase in cost to the Owner or the Architect/Engineer. Modifications to head spacing, pipe routes, etc. shall be closely coordinated with the work of all other trades. The Fire Sprinkler Subcontractor shall be responsible for the design and installation of the fire sprinkler system as described herein and on the project drawings. The piping of the system shall be sized using the "hydraulic" method, as included in NFPA Standard No. 13. Piping sized using the "schedule" method is unacceptable, except where expanding an existing "scheduled" system.
4. Shop Drawings: Shop Drawings shall be submitted prior to fabrication. The Shop Drawings shall include detail plans of sprinkler systems including piping sizes, sections and plot plan indicating the locations of underground supply connections, control valves, fire department connections, and other equipment to be used. The Shop Drawings shall become an integral part of these Specifications.
5. Materials and Equipment:
 - a. General: All materials and equipment used in the installation of the sprinkler system shall be listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials, or the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard, and shall be the latest design of the manufacturer. All piping, control valves, drain valves, fittings, etc. shall be as specified under this Section, Fire Protection System, & in Section 22 20 00 utilizing welded, flanged, and threaded fittings only. Where valves are not specified by Figure No. they shall be of specified manufacture, U.L. listed for service, and of same quality level as Figure Nos. specified. All pipe 2 1/2" and larger shall be welded, except as may be allowed herein. All pipe 2" and smaller shall be threaded using Class 150 pound malleable iron, A135 Schedule 40 black steel pipe and fittings. Note that if galvanized pipe or fittings are installed in other than dry systems, the contractor shall be responsible to remove the galvanized pipe or fittings and replace them with specified materials as soon as possible prior to further installation of the system. (EXCEPTION: Dry pipe systems shall be hot dipped galvanized pipe and fittings of same schedule as dry systems, per Factory Mutual recommendations.)
6. Sprinkler Heads:
 - a. Unless otherwise specified or indicated on the Drawings, sprinkler heads shall be quick response type spray heads of the upright or pendant ordinary degree temperature rating type except that sprinkler heads to be installed in the vicinity of heating equipment and lights shall be of the temperature rating required for such locations by National Fire Protection Association Standard No. 13. Chrome plated bronze heads shall be installed in all locations. Ceiling sprinklers shall be Tyco No. Ty-FRB semi-recessed with white finish and polished chrome plated brass sprinkler head. Uprights shall be Tyco No. Ty-FRB.
 - b. Heads shall be located in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc., and where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions.

- c. The Contractor shall provide spare heads equal to one percent (1%) of the total number of heads installed under the Contract, but not less than ten (10). The heads shall be packed in a suitable wall mounted sprinkler cabinet and shall be representative of, and in proportion to, the number of each type and temperature rating heads installed. In addition to the spare heads, the Contractor shall provide not less than one special sprinkler head wrench for each type of head. The cabinet shall be located where directed by the Construction Inspector.
 7. Piping: Installation of piping, fittings and valves shall be as specified in Chapter 3, System Components, NFPA Standard No. 13, except where noted otherwise. Piping shall be concealed in all areas with finished ceilings. Piping shall be sterilized as specified in Section 21 20 00. The O.S. & Y. valves shall be provided as specified herein.
 8. Note that the use of piping bushings for any purpose is explicitly prohibited.
 9. Water Flow Alarm Switch: Provide, where indicated on the Drawings, McDonnell UL approved line size flow switches. Flow switch shall be provided with delay, adjustable up to 90 seconds (60 to 90 seconds in Austin). See Division 26 for electrical signal connection by others to these flow switches.
- H. Add locations and hazards as required by project conditions.
- | | |
|------------------|--------------------------|
| Location | System Type/Hazard |
| Offices, Lobbies | Light Hazard |
| Warehouses | Ordinary Hazard, Group 2 |
| Laboratories | Ordinary Hazard, Group 2 |
| Mechanical Rooms | Ordinary Hazard, Group 2 |
| Computer Rooms | Light Hazard, Pre-action |
| Classrooms | Light Hazard |
| Storage Rooms | Ordinary Hazard, Group 2 |

PART 3 - EXECUTION

3.1 PREPARATION - ALL SYSTEMS:

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Flush entire system of foreign matter prior to installation of sprinkler heads.

3.2 INSTALLATION

A. SPRINKLERS

1. Install piping in accordance with NFPA 13 for sprinkler systems, and NFPA 24 for service mains. Note that the piping sizes indicated in the plans are the minimum acceptable. The Qualified Contractor shall provide proper sizes, materials and installation as required in the appropriate NFPA Standard.
2. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient. See Section 21 00 00 and 21 05 29.
3. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
4. Provide drain valves at main shut-off valves, low points of piping and apparatus. Provide Fire Department test station, piped to drain.
5. Locate outside alarm gong on building wall as indicated.
6. Place pipe runs to minimize obstructions with other work.
7. Place piping in concealed spaces above finished ceilings.
8. Center heads in two directions in ceiling tile and provide piping offsets as required.
9. Apply paper cover to ensure concealed sprinkler head and cover plates do not receive field paint finish.
10. Install and connect fire pumps in accordance with Section 21 30 00 and NFPA 13.

11. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.

END OF SECTION 21 13 13

SECTION 22 00 00 – BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED DOCUMENTS

- A. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and Division 01 of the specifications apply to the work specified in this section.
- B. All work covered by this section of these specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

1.3 GENERAL

- A. The Contractor shall execute all work hereinafter specified or indicated on accompanying drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the drawings.
- B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
- C. The plumbing, mechanical, electrical, and associated drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- D. When the mechanical, plumbing, and electrical drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping is generally intended to be installed true and square to the building construction, and located as high as possible against the structure. The drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.4 DEFINITIONS

- A. Concealed/exposed: Concealed areas are those that cannot be seen by the building occupants. Exposed areas are all areas that are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.
- B. General Requirements: The provisions of requirements of other Division 01 sections apply to entire work of contract and, where so indicated, to other elements that are included in project. Basic contract definitions are included in the General Conditions.
- C. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.

- D. Directed, requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect/Engineer," "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
 - E. And/Or: Where "and/or" is used in these specifications or on the drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor."
 - F. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
 - G. As required: Where "as required" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
 - H. Furnish
 1. The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations."
 2. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."
 - I. Install: The term "install" is used to describe operations at project site including "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operation."
 - J. Provide: The term "provide" means "to furnish and install, complete and ready for intended use."
- 1.5 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS
- A. General: Refer to Division 01 for construction phasing and time increments.
 - B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. If city or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.
 - C. All work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to city controlled services. If inspections by city personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
 - D. Compliance: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

1.6 CONTRACT DOCUMENTS

- A. All dimensional information related to new structures shall be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- B. The interrelation of the specifications, the drawings, and the schedules are as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following the contractually prescribed information flow requirements.
- C. Should the drawings or specifications conflict within themselves, or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished.

1.7 WORK SEQUENCE

- A. Install work in phases to accommodate Owner's occupancy requirements during the construction period coordinate mechanical schedule and operations with [Owner] [Architect/Engineer]:

1.8 ALLOWANCES

- A. Cash Allowance: Refer to Division 01 of the Construction Documents for information and requirements.

1.9 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates: See "Special Conditions" and Bid Form.
- D. Any Alternate Proposals are summarized in Division 01 of the specifications. The Contractor is directed to refer to all sections of the specifications and drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.10 SUBMITTALS

- A. Refer to Division 1, UGC, and supplemental UGCs for specification requirements pertaining to timeliness of submission and review, quantity, and format. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
- B. Proposed Products List: Include Products specified in the following sections:
 - 1. Section 22 05 13 – Plumbing Motors
 - 2. Section 22 05 29 – Plumbing Supports and Sleeves
 - 3. Section 22 05 48 – Plumbing Vibration Isolation
 - 4. Section 22 05 53 – Plumbing Identification
 - 5. Section 22 07 19 – Plumbing Insulation
 - 6. Section 22 11 23 - Plumbing Equipment
 - 7. Section 22 13 16 - Plumbing Piping
 - 8. Section 22 13 16.A - Plumbing Specialties
 - 9. Section 22 15 13 – Compressed Air System
 - 10. Section 22 20 00 – Plumbing, Piping, Valves and Fittings
 - 11. Section 22 40 00 - Plumbing Fixtures
 - 12. Section 22 62 19 – Laboratory Vacuum Systems
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories clearly marked and/or highlighted, with non-applicable information or data clearly noted in a single submittal.
- D. Mark dimensions and values in units to match those specified.

- E. Submit fabrication drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment, (3) where called for elsewhere in these specifications; and (4) where specifically requested by the Architect/Engineer. Fabrication drawings shall be made at no additional charge to the Owner or the Architect/Engineer.
- F. All required fabrication drawings, except as noted otherwise, shall be prepared at a scale of not less than 1/4" = 1'-0." Fabrication plans, and sections in Mechanical Rooms shall be drawn at a minimum scale of 3/8" = 1'-0." Submit three prints of each fabrication drawing to the Architect/Engineer for review. Reproduction and submittal of the Construction Documents is not acceptable. The Architect/Engineer will review the drawing and return one print with comments.
- G. Contractor shall submit a copy of the specifications with each submittal, marking compliance or deviation next to each paragraph. If a deviation is taken, contractor must provide written explanation as to what the deviation is and why it had to be taken. If a submittal does not contain the marked copy of the specifications, it is grounds for a rejected submittal without product review.
- H. All submittals that are re-submittals shall include written responses to all previous review comments. Failure to provide written responses will result in the submittal being rejected without product review.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General: Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment that will be submitted for incorporation into the project. The list shall be arranged in accordance with the organization of the specifications. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval. The initial list shall be submitted as herein specified. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these specifications have been met and samples shall be furnished when requested. All manufacturers' data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
- C. It is not the intent of the drawings and/or specifications to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- D. The specified products have been used in preparing the drawings and specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the Architect/Engineer is final.
- E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.

- F. **Timeliness:** The burden of timeliness in the complete cycle of submittal data, shop drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
 - G. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
 - H. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
 - I. **Certification:** The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the specifications.
 - J. **Physical Size of Equipment:** Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
 - K. **Materials and Equipment Lists:** Eight (8) copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer. The lists shall be accompanied by eight (8) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the shop drawings. Such lists shall include but will not be limited to the following items:
 - L. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.
- 1.12 MATERIALS AND WORKMANSHIP
- A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site but shall be replaced with new materials and/or equipment.
 - B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.
- 1.13 FLAME SPREAD PROPERTIES OF MATERIALS
- A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.14 REGULATORY REQUIREMENTS

- A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications. All referenced codes and standards shall be those current at the date of issue of the design documents.
- B. National Fire Protection Association Standards (NFPA)
 - 1. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
 - 2. NFPA No. 51, Welding & Cutting, Oxygen-Fuel Gas Systems
 - 3. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
 - 4. NFPA No. 70, National Electrical Code
 - 5. NFPA No. 99, Health Care Facilities
 - 6. NFPA No. 101, Life Safety Code
 - 7. NFPA No. 241, Standard for Safeguarding Construction, Alteration and Demolition Operations
 - 8. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials
 - 9. NFPA No. 258, Standard Research Test Method for Determining Smoke Generation of Solid Materials
- C. American National Standards Institute (ANSI)
- D. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories
- E. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes
- F. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.
- G. American Water Works Association (AWWA): All current editions of applicable manuals and standards.
- H. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.
- I. City of Houston, Fire Department as may be applicable to construction on this site.
- J. International Plumbing Code, (Includes the International Mechanical and International Building Codes)
- K. Texas Occupational Safety Act: All applicable safety standards
- L. Occupational Safety and Health Act (OSHA)
- M. ADA and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards and the requirements of the American Disabilities Act.
- N. Refer to specification sections hereinafter bound for additional Codes and Standards.
- O. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. In all cases where Underwriters Laboratories, Inc. has established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
- P. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 01 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.15 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
- B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
- C. Conformance with Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
- D. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
- E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8" on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item. Where steel is specified to be hot dip galvanized, mill galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
- F. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
- G. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.16 WALL, FLOOR AND CEILING PLATES

- A. See Section 22 05 29 – Plumbing Supports and Sleeves

1.17 SLEEVES, INSERTS, AND FASTENINGS

- A. See Section 22 05 29 – Plumbing Supports and Sleeves

1.18 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other sections. Obtain permission of [Owner] [Architect/Engineer] before proceeding.

1.19 MANUFACTURER'S RECOMMENDATIONS

- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturer's directions, and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.20 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of plumbing equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.21 LARGE APPARATUS

- A. Any large piece of apparatus that is to be installed in any space in the building, and that is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.22 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

1.23 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.24 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

- A. The Contractor shall note that the electrical design and drawings are based on the equipment scheduled and indicated on the drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

- B. The electrical trades shall provide all interconnecting wiring for the installation of all power. The electrical trades shall provide all disconnect switches as required for proper operation, as indicated on the drawings or required by applicable code. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 22, shall be provided under the scope of Division 26.
- C. The Plumbing Trade shall provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review within thirty (30) days after the submittals for equipment have been reviewed. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control drawings, not a series of manufacturer's individual diagrams. After these diagrams have been reviewed by the Architect/Engineer, copies shall be transmitted to the electrical trades by the Contractor. They shall be followed in detail.

1.25 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)
- B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the drawings, the matter shall be referred to the A/E for ruling.

1.26 SITE OBSERVATION

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.27 PRECEDENCE OF MATERIALS

- A. The specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.
- B. The installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way." Refer to Part 3 of these specifications.

1.28 CONNECTIONS FOR OTHERS

- A. The Plumbing Contractor shall rough in for and make all gas, water, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.

1.29 INSTALLATION METHODS

- A. Where to Conceal: All pipes, etc., shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.

- B. Support: All piping and ducts shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- C. Maintaining Clearance: Where limited space is available above the ceilings below concrete beams or other deep projections, pipe shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration.

1.30 RECORDS FOR OWNER

- A. The Contractor shall maintain a set of "blue-line" prints in the Field Office for the sole purpose of recording "installed" conditions. Daily note all changes made in these drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- B. At contract completion, the Contractor shall provide an electronic file of the revised drawings. The contractor shall transfer the information from the "blue-line" prints maintained as described above, and turn over this neatly marked set of reproducible drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these specifications, and to the Uniform General Conditions, for additional information. These drawings shall include as a minimum:
 - 1. Addendum written drawing changes.
 - 2. Addendum supplementary drawings.
 - 3. Accurate, dimensioned locations of all underground utilities, services and systems.
 - 4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 - 5. Change Order written drawing changes.
 - 6. Change Order supplementary drawings.
- C. Electronic Media
 - 1. The contractor shall submit three sets of discs containing all the drawings in AUTOCAD 12 or 14 format.
- D. "As installed" plans shall bear a stamp, "stick-on decal" or lettered title block generally located in lower right hand corner of drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.
- E. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in duplicate, prepared in a neat brochure or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.
 - 1. All warranties and guarantees and manufacturers' directions on equipment and material covered by the Contract.
 - 2. Two sets of operating instructions for heating and cooling and other mechanical and electrical systems. Operating instructions shall also include recommended preventative maintenance and seasonal changeover procedures.
 - 3. Valve tag charts and diagrams specified herein.
 - 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 - 5. Copies of approved shop drawings.
 - 6. Any and all other data and/or drawings required as submittals during construction.
 - 7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.

1.31 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

- B. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes, etc., shall be core drilled to exact size.
- C. Restoration: All openings shall be restored to "as new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.
- E. Plaster: All plumbing work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. Special Note: No cutting, boring, or excavating that will weaken the structure shall be undertaken.

1.32 ACCESS DOORS

- A. General: This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.
- B. Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

1.33 OPERATION PRIOR TO COMPLETION

- A. When any piece of plumbing equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Project Manager or Construction Inspector's written permission to do so. The warranty period shall, however, not commence until the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

1.34 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workers, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall them upon completion of work in the areas affected.

- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, etc.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.35 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.36 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Check inspections shall include plumbing equipment, insulation, controls and such other items hereinafter specified or specifically designated by the Architect/Engineer.

1.37 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

1.38 CLEANING AND PAINTING

- A. All equipment, piping, insulation, etc., furnished and installed in exposed areas under Division 22 of these specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification.

- B. All purchased equipment furnished by the mechanical and electrical subcontractors shall be delivered to the job with a suitable factory protective finish with the colors hereinafter specified. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
- C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metalwork shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- D. Color of finish painting in Mechanical Rooms shall be painted in accordance with The University of Texas Standard Color Schedule for machinery spaces using Pratt and Lambert, Inc.'s "Effector" enamel, or approved equal. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

ITEM	COLOR	"P and L" PAINT NUMBER
Equipment Bases	Light Green	YG493M (Winter Pear)
Equipment	Green	YG511Y (Biscay Green)
Piping (Insulated	Light Gray	B798M (London Fog)
	and Uninsulated)	
Hanger Rods	Same as "Piping" above	
Metal Exposed to High Temperatures	Same as "Piping" above, high temp rated	
Atmospheric Relief Line	Same as "Piping" above	
Valve Hand Wheels	Blue	B726M (Siam Blue)
Pump Couplings and Fuel Gas Piping (including natural gas, LPG, etc.)	Safety Yellow	Y361M (Daisy Yellow)

- E. Jacketing on insulation shall not be painted.
- F. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.
- G. Scope of painting for Divisions 22--work in areas other than those defined as "exposed" is as follows:
 1. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers in underfloor spaces shall be cleaned and painted with two coats of Tropical Paint Co. No. 77-black asphaltic emulsion. Galvanized steel and copper lines in these spaces shall not be painted.
 2. All fuel piping (natural gas, LPG, etc.) piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fuel piping shall be painted safety yellow, and fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA.
 3. If insulated, the piping shall be primed, only, prior to insulation, and the insulation jacketing shall be painted as specified for piping. The requirements of this paragraph are "primary" and have priority over any conflicting specification or instruction, should a conflict in the Construction Documents exist.
- H. In addition to painting in mechanical rooms, materials, piping, plumbing, supports, foundations, equipment and appurtenances installed by the subcontractors in exposed areas shall be finish painted with two coats of Pratt and Lambert, Inc.'s "Effector" enamel of color selected by the Architect/Engineer.

- I. Additional areas to be defined as "exposed" for purposes of painting, are defined as follows: (Note that paragraph 1.3.10 of this section defines exposed areas for the balance of the project. The areas listed below are to be painted in addition to exposed areas as previously defined.)

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.
- C. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by plumbers skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.
- D. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be supplied by a non-domestic manufacturer provided they fully comply with Contract Documents.
- E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.2 NAMEPLATES

- A. Each major component of equipment shall have a manufacturer's nameplate, address, and model number on the nameplate, securely attached to the equipment. All data on nameplates shall be legible at the time of Final Inspection.
- B. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.
- C. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.
 1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.3 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes, passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.
- B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.
- C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.

- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- C. Space Requirements:
 - 1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
 - 2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.
- D. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

3.2 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- D. All pipe, shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All pipes run exposed equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
 - 1. All piping not directly buried in the ground shall be considered as "interior piping."
 - 2. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All plumbing work at and above the ceiling, including items supported by the ceiling grid, shall be complete and installed in accordance with contract requirements. Adequate lighting shall be provided to permit thorough inspection of all above ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Architect/Engineer, Physical Plant, Resident Construction Manager's Construction Inspector(s) and the Project Manager, Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
 - 3. The purpose of this inspection is to verify the completeness and quality of the installation of the plumbing systems, and any other special above ceiling systems such as vacuum systems. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - 4. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.
- E. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days or as agreed by owner prior to the inspection.
- F. Precedence of Materials:
 - 1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.
 - 2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":
 - a. Building lines
 - b. Structural members
 - c. Structural support frames supporting ceiling equipment

- d. Electric tracked vehicle system
 - e. Pneumatic trash and linen system
 - f. Pneumatic tube system
 - g. Soil and drain piping
 - h. Vent piping
 - i. Supply, return and outside air ductwork
 - j. Exhaust ductwork
 - k. HVAC water and steam piping
 - l. Condensate piping
 - m. Fire protection piping
 - n. Natural gas piping
 - o. Medical/Laboratory gases
 - p. Domestic water (cold and hot, softened, treated)
 - q. Refrigerant piping
 - r. Electrical conduit
3. Coordinate fire suppression, plumbing and HVAC systems with transport systems as required to maintain transport system right-of-way.

3.3 TESTING

- A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials, and labor for making such tests. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner. Fuel and electrical energy costs for system adjustment and tests that follow beneficial occupancy by the Owner will be borne by the Owner.
- B. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.
- C. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.
- D. Notify the Project Manager and the Architect/Engineer in writing at least five days calendar days or as agreed by owner prior to each test and prior to other Specification requirements requiring the Project Manager and Architect/Engineer to observe and/or approve tests.
- E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.
- F. The Construction Inspector shall be notified in writing at least 5 working days or approved by owner prior to each test and other specification requirements requiring action on the part of the Construction Inspector. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.
- G. Maintain Log of Tests as hereinafter specified.
- H. See specifications hereinafter for additional tests and requirements.
- I. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.4 TRAINING

- A. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."
- B. Specific training and operating instructions for individual equipment components shall be as specified in the individual Specification Sections.

END OF SECTION 22 00 00

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SECTION 22 05 13 – PLUMBING MOTORS

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
 - A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
 - A. Single phase electric motors
 - B. Three phase electric motors
 - C. The Contractor shall provide all motors required for equipment supplied under this Division of the work
- 1.3 RELATED WORK
 - A. Section 22 11 23 - Plumbing Equipment
 - B. Section 22 13 16.A - Plumbing Specialties
 - C. Section 22 63 13 - Medical Gas Systems
- 1.4 REFERENCES
 - A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
 - C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators
 - D. ANSI/NEMA MG 1 - Motors and Generators
 - E. ANSI/NFPA 70 - National Electrical Code
- 1.5 SUBMITTALS
 - A. Submit product data under provisions of Section 22 00 00
 - B. Submit test results verifying nominal efficiency and power factor for motors 1 horsepower and larger.
 - C. Submit manufacturer's installation instructions under provisions of Section 22 00 00
- 1.6 OPERATION AND MAINTENANCE DATA
 - A. Submit operation and maintenance data under provisions of Section 22 00 00
 - B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.
- 1.7 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacture of electric motors for commercial use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- 1.8 REGULATORY REQUIREMENTS
 - A. Conform to ANSI/NFPA 70.
- 1.9 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver products to site under provisions of Section 22 00 00.

- B. Store and protect products under provisions of Section 22 00 00.
- C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.10 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Section 22 00 00.
- B. Warranty: Include coverage for motors 1 horsepower and larger.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Electrical Service: Refer to Drawing schedules for required electrical characteristics.
- C. Design for continuous operation in 40 degrees C environment and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor and motor enclosure type.
 - 1. Open Drip-proof Motors: Design for a service factor of 1.15 and a 90 degrees C temperature measured above 40 degrees C room ambient .
 - 2. Totally Enclosed Motors: Design for a service factor of 1.00 and an 80 degrees C maximum temperature rise in the same conditions.
- D. Visible Stainless Steel Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.
- E. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame. Provide adequately sized metal electrical connection box for conduit connection.
- F. Motors shall be built in accordance with the latest ANSI, IEEE and NEMA Standards and shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled and of approved manufacturer as listed below or of the same manufacturer as the equipment which they serve. Nameplate rating of motors shall match the characteristics scheduled.
- G. All motors shall be designed for normal starting torque unless the driven machine requires high starting torque and shall be selected for quiet operation, free from magnetic hum.
- H. All motors shall be provided with adequately sized electrical connection box with threaded hub for attachment of flexible conduit, unless bus duct connection is indicated. Where motors are connected to driven equipment by the use of a V-belt drive, they shall be furnished with adjustable rails.
- I. Dynamic Balance shall be no greater than the vibration limits of the driven equipment as defined in the specifications.
- J. All motors shall be provided with all copper windings, terminal wiring, and copper or bronze lugs. AL/CU rated connectors are not allowed.

2.2 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve or ball bearings.

- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.
- F. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors with drip-proof enclosures except as hereinafter specified. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.
- E. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Enclosures shall be of the open drip-proof type with a service factor of 1.15 and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.
- H. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.5 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Enclosures shall be of the open drip-proof type with a service factor of 1.15 (motor shall not run in Service Factor under normal operating conditions), and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.
- B. In general, all motors 3/4 horsepower and larger, unless smaller motors are indicated to be supplied as 3-phase, shall be 3-phase and shall be squirrel cage high efficiency induction type with standard NEMA frame sizes.
- C. Motors 1 HP and larger shall have integral frames.
- D. Starting Torque: Between one and one and one-half times full load torque.
- E. Starting Current: Six times full load current.
- F. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B Characteristics.

- G. Design, Construction, Testing, and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.
 - H. Insulation System: NEMA Class B or better.
 - I. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data. Test and balance motors to limits defined in 2.01J.
 - J. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - K. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 26. Bearings: Ball or roller type, double shielded with continuous grease relief to accommodate excessive pressure caused by thermal expansion or over lubrication. All motor bearings shall be factory pre-packed with a non-detergent lubricant, and shall be provided with lubrication fitting arranged to provide easy access when installed on the driven apparatus except as noted hereinafter. Permanently lubricated factory-sealed motors may be provided in fractional HP sizes only where they are an integral part of a piece of approved apparatus. All bearings shall be designed for L-10, 200,000 hour minimum life hours of continuous service. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 - L. Sound Power Levels: Refer to ANSI/NEMA MG 1.
 - M. Part Winding Start [Where Indicated:] [Above 254T Frame Size:] Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
 - N. Weatherproof Epoxy [Sealed] [Treated] Motors (Where Indicated): Epoxy [seal windings using vacuum and pressure] [coat windings] with rotor and starter surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.
 - O. Nominal Efficiency: Meet or exceed values per 22 05 13-3.03 at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
 - P. Nominal Power Service Factor: Meet or exceed values per 22 05 13-3.02 at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
 - Q. Motors 1 HP and larger shall be provided with a copper frame grounding lug of hydraulic compression design, for installation by the electrical subcontractor.
 - R. Motors 3/4 HP and larger shall have 120V space heater that is energized only when motor is idle. (Galveston only.)
 - S. Motors 10hp and larger shall be inverter duty rated and shall be provided with shaft grounding device.
- 2.6 STARTING EQUIPMENT:
- A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted. The Mechanical Subcontractor shall furnish all starters for Division 23 work, except those starters scheduled to be provided in Division 26.
 - B. Motor starters shall conform to NEMA Standards for Industrial Control, #IC-1, latest issue, and shall be housed in NEMA Standard enclosures. Control voltage in each starter shall be not more than 120 volts to ground, with an individual control transformer provided in each starter as required. Manual starters for fractional horsepower single-phase motors shall be on-off or snap switch type combined with thermal overload device. The switch shall be so constructed so that it cannot be held closed under a sustained motor overload.

- C. Magnetic starters shall have thermal overload protection in each of the ungrounded legs and shall be solenoid operated. Provide the correct size heater element to protect the motor and allow it to operate based on motor nameplate amperes and ambient temperatures anticipated for each individual motor. Each starter shall be provided with a control power transformer or 120v control power circuit.
- D. Pushbuttons with or without pilot lights, hand-off-automatic switches and other scheduled apparatus shall be standard duty type mounted in NEMA enclosures or in cover of starter as specified or scheduled, and shall be furnished by the trade furnishing the starter except as specifically indicated elsewhere.
- E. Hand-Off-Automatic switches for equipment which could damage itself if left in the "hand" position (such as sump pumps), shall be spring return to "off" from the "hand" position.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Motors drawing less than 250 Watts and intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.
- B. Motors shall be open drip-proof type, except where specifically noted otherwise.
- C. Motors shall be energy efficient type.
- D. Single phase motors for pumps shall be capacitor start type.
- E. Motors be totally enclosed weatherproof epoxy-treated type.

3.2 NEMA OPEN MOTOR SERVICE FACTORS

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

3.3 MOTOR EFFICIENCIES* – NOMINAL, FULL LOAD, THREE PHASE

Minimum Nominal Full Load Efficiency (5) for Motors Manufactured on or after December 19, 2010								
Number of Poles	Open Drip-Proof Motors				Totally Enclosed Fan Cooled Motors			
	2	4	6	8	2	4	6	8
Synchronous Speed (RPM) →	3600	1800	1200	900	3600	1800	1200	900
Motor Horsepower								
1	NR	82.5	80.0	74.0	75.5	82.5	80.0	74.0
1.5	82.5	84.0	84.0	75.5	82.5	84.0	85.5	77.0
2	84.0	84.0	85.5	85.5	84.0	84.0	86.5	82.5
3	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
5	85.5	87.5	87.5	87.5	87.5	87.5	87.5	85.5

7.5	87.5	88.5	88.5	88.5	88.5	89.5	89.5	85.5
10	88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5
15	89.5	91.0	90.2	89.5	90.2	91.0	90.2	88.5
20	90.2	91.0	91.0	90.2	90.2	91.0	90.2	89.5
25	91.0	91.7	91.7	90.2	91.0	92.4	91.7	89.5
30	91.0	92.4	92.4	91.0	91.0	92.4	91.7	91.0
40	91.7	93.0	93.0	91.0	91.7	93.0	93.0	93.0
50	92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
60	93.0	93.6	93.6	92.4	93.0	93.6	93.6	91.7
75	93.0	94.1	93.6	93.6	93.0	94.1	93.6	93.0
100	93.0	94.1	94.1	93.6	93.6	94.5	94.1	93.0
125	93.6	94.5	94.1	93.6	94.5	94.5	94.1	93.6
150	93.6	95.0	94.5	93.6	94.5	95.0	95.0	93.6
200	94.5	95.0	94.5	93.6	95.0	95.0	95.0	94.1
250	94.5	95.4	95.4	94.5	95.4	95.0	95.0	94.5
300	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
350	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
400	95.4	95.4	NR	NR	95.4	95.4	NR	NR
450	95.8	95.8	NR	NR	95.4	95.4	NR	NR
500	95.8	95.8	NR	NR	95.4	95.8	NR	NR

RE: ANSI/ASHRAE/IES Standard 90.1-ZD10, Table 10.8c minimum nominal full-load efficiency of general purpose electric motors (subtype 11 and design 13)

1. *Reference NEMA MG 1-2006 Table 12-12.

END OF SECTION 22 05 13

SECTION 22 05 29 – PLUMBING SUPPORTS AND SLEEVES

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Pipe and equipment hangers and supports
 - B. Equipment bases and supports
 - C. Sleeves and seals
 - D. Flashing and sealing equipment and pipe stacks
- 1.3 RELATED SECTIONS
- A. Section 03300 - Cast-In-Place Concrete: Equipment bases
 - B. Section 07 84 00 - Firestopping: Joint seals for piping and duct penetration of fire rated assemblies
 - C. Section 09 91 00 – Painting
 - D. Section 22 05 48 – Plumbing Vibration Isolation
 - E. Section 22 07 19 – Plumbing Insulation
 - F. Section 22 11 23 – Plumbing Equipment
 - G. Section 22 13 16 – Plumbing Piping
- 1.4 REFERENCES
- A. ASME B31.1 - Power Piping
 - B. ASME B31.2 - Fuel Gas Piping
 - C. ASME B31.9 - Building Services Piping
 - D. ASTM F708 - Design and Installation of Rigid Pipe Hangers
 - E. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer
 - F. MSS SP69 - Pipe Hangers and Supports - Selection and Application
 - G. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
 - C. Product Data: Provide manufacturers catalog data including load capacity.
 - D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.
- 1.6 REGULATORY REQUIREMENTS
- A. Conform to applicable code for support of plumbing and piping.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 MANUFACTURERS

- A. Hangers and Supports:
 - 1. Anvil International.
 - 2. Kinder.
 - 3. Unistrut.
- B. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping. Shop Drawings shall be provided, indicating locations and details of anchors, guides, expansion loops and joints, hangers, etc. The hanger design shall conform to the ASME Code for Pressure Piping.
- C. All auxiliary steel required for supports, anchors, guides, etc. shall be provided.
- D. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
- E. All Supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- F. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.
- G. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.
- H. Guide points shall be located and constructed wherever required or indicated on Drawings and at each side of an expansion joint or loop, to permit free axial movement only.
- I. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- J. Hangers supporting and contacting brass or copper lines 3" in size and smaller shall be Anvil Fig. CT-65, adjustable, copper plated, clevis hanger. Hangers supporting and contacting brass or copper lines 4" and larger shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. For insulated copper or brass domestic water lines, hangers for all sizes of pipe shall be Anvil Fig. 300, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. Isolate all copper or brass lines from all ferrous materials with approved dielectric materials. Hangers supporting and contacting plastic or glass piping shall be of equal design, but shall be padded with neoprene material or equal. The padding material and the configuration of its installation shall be submitted for approval.
- K. Hangers supporting insulated lines where the outside diameter of the insulation is the equivalent of 8" diameter pipe or smaller in size and supporting all ferrous lines 6" and smaller in size shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.
- L. Hangers supporting and contacting ferrous lines larger than 6" in size and outside of insulation on lines with the outside diameter equivalent to 10" diameter pipe shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.

- M. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the owner.
- N. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines where specified. Hangers for dual or low temperature insulation pipes shall bear on the outside of the insulation, which shall be protected by support shields as specified in Section 22 07 19 - PLUMBING INSULATION. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. Hangers for high temperature insulated pipes and all insulated hot and cold domestic water pipes shall be encased in the insulation unless supported by trapezes in which case shield and rigid insulation shall be provided as specified above for low temperature insulated pipes.
- O. Supports for vertical piping in concealed areas shall be double bolt riser clamps, Anvil Fig. 261, or other approved equal, with each end having equal bearing on the building structure, and located at each floor. Two-hole rigid pipe clamps at 4 ft. o.c. or steel framing channels and Anvil Fig. 261 riser clamps may be used to support pipe directly from vertical surfaces or members where lines are not subject to expansion and contraction. When piping is subject to expansion and contraction, provide spring isolators (see Section 22 05 48 – Plumbing Vibration Isolation). Where brass or copper lines are supported on trapeze hangers or steel framing channels the pipes shall be isolated from these supports with plastic tape with insulating qualities, or strut clamps as manufactured by Specialty Products Company, Stanton, California.
- P. Supports for vertical piping in exposed areas shall be attached to the underside of the building structure above the top of the riser, and the underside of the penetrated structure. The contractor shall use a drilled anchor as specified above, and use a Anvil No. 595 Socket Clamp with Anvil No. 594 Socket Clamp Washers, as a riser clamp. The top riser hanger shall consist of two (2) hanger rods (sized as specified) anchored to the underside of the building structure, supporting the pipe by means of the material specified. Risers penetrating floors shall be supported from the underside of the penetrated floor as specified for the top of the riser.
- Q. Pipe Supports in Chases and Partitions: Horizontal and vertical piping in chases and partitions shall be supported by hangers or other suitable support. Pipes serving plumbing fixtures and equipment shall be securely supported near the point where pipes penetrate the finish wall. Supports shall be steel plate, angles, or special channels such as Unistrut mounted in vertical or horizontal position. Pipe clamps such as Unistrut P2426, P2008, P1109 or other approved clamps shall be attached to supports. Supports shall be attached to wall or floor construction with clip angles, brackets, or other approved method. Supports may be attached to cast iron pipe with pipe clamp, or other approved method. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action.
- R. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- S. Vibration Isolation: Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc.). Piping that may vibrate and create an audible noise shall also be isolated. Spring hangers or supports shall be provided where indicated on the Drawings and/or specified under Section 22 05 48.
- T. Attachment:
1. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
 2. Inserts shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
 3. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.

4. Hangers shall be attached to the structure as follows:
 - a. Poured In Place Concrete: Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists. The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - b. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - c. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 - d. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 - e. Pre-Cast Tee Structural Concrete: Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod. Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees."
 - f. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 - g. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
 - h. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- U. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Cooper B-line, Uni-Strut, Power Strut, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- V. Finishes: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, and brackets, shall be Zinc-electroplated, galvanized or copper-electroplate finish. Universal concrete inserts shall be cadmium plated.
- W. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.

2.3 ACCESSORIES

- A. Hanger Rods: Galvanized mild steel threaded both ends, galvanized threaded one end, or galvanized continuous threaded.

- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.

2.4 FLASHING AND EQUIPMENT CURBS

- A. Metal Flashing: 26 gauge galvanized (stainless steel) steel.
- B. Metal Counterflashing: 22 gauge galvanized (stainless steel) steel.
- C. Roofing Flashing: See specifications for Roofing, elsewhere in these Specifications.
- D. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.
- E. Curbs: Welded 18 gauge galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, factory installed wood nailer.

2.5 CONCRETE FOUNDATIONS ("HOUSEKEEPING PADS"):

- A. Concrete foundations for the support of equipment such as floor mounted panels, pumps, fans, air handling units, etc., shall extend 4" on all sides beyond the limits of the mounted equipment unless otherwise noted and shall be poured in forms built of new dressed 6" nominal lumber. All corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with Carborundum. Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with Shop Drawings submitted by the Contractor for review by the Architect/Engineer.

2.6 WALL, FLOOR AND CEILING PLATES:

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. All equipment rooms are classified as finished areas. Floor penetrations in exposed (except in stair wells) areas shall be finished using 'bell' fitting to fit pipe or insulation and sleeve and shall be painted to match the pipe. Penetrations in stairwells shall have flat floor plate painted to match pipe.

2.7 SLEEVES

- A. General: All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved. All penetrations must pass through sleeves. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing vertical solid concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
 1. Sleeve material for floors and exterior walls shall be Schedule 40 galvanized steel with welded water stop rings.
 2. Sleeves through interior walls to be galvanized sheet metal with gauge as required by wall fire rating, 20 gauge minimum.

- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4", except that the minimum clearance shall accommodate a Thunderline Link-seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, etc., plus any specified insulation. Void between sleeve and pipe in interior penetrations shall be filled for rated wall and/or floor penetrations as specified in Division 7 Section - Fire Stop Systems.
- C. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- D. Vermin proofing: The open space around all, piping, etc., passing through the ground floor and/or exterior walls shall be vermin proofed in a manner acceptable to the Architect/Engineer.
- E. Waterproofing: The annular space between a pipe and its sleeve in interior floors shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of floor.
- F. Air Plenums: The space around piping, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.

- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed, but shall be corrosion protected with galvanized plating. Repair any damaged galvanized plating with a coating of 'Galvalum'.
- L. Hanger Rods: (NOTE: All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the contractor shall take appropriate measures to protect the pipe or other materials from damage.)

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- C. Seal floor, shower, mop sink, and drains watertight to adjacent materials.
- D. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Insure sleeves extend through floors (except in stairwells) two inches above finished floor level and sleeves through floors shall have welded waterstop rings. Sleeves shall be sealed watertight to floors and pipe.
- D. Where exposed piping penetrates floor, ceiling, or wall, close space between pipe and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.
- E. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.6 PIPE SUPPORT SCHEDULES

STEEL PIPE SIZE Inches	MAX. HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8
14 and Over	20	1
PP, PVDF, PVC, CPVC (All Sizes)	4	3/8

C.I. Bell and
Spigot (or No-Hub),
and at all Joints

5

5/8

END OF SECTION 20 05 29

SECTION 22 05 48 – PLUMBING VIBRATION ISOLATION

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. 22 00 00 -- Basic Plumbing Requirements
 - B. 22 05 29 – Plumbing Supports and Sleeves
 - C. 22 05 53 – Plumbing Identification
- 1.2 WORK INCLUDED
- A. Inertia bases
 - B. Vibration isolation
- 1.3 SCOPE OF WORK:
- A. Furnish and install all labor, materials, equipment tools and service and perform all operations required in connection with or properly incidental to the construction of complete system of vibration and noise control, as indicated on the Drawings, reasonably implied therefrom or as specified herein, unless specifically excluded.
- 1.4 REFERENCES
- A. ASHRAE - Guide to Average Noise Criteria Curves
- 1.5 QUALITY ASSURANCE
- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition
- 1.6 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 22 00 00.
 - B. Indicate inertia bases on shop drawings.
 - C. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.
 - D. Submit manufacturer's installation instructions under provisions of Section 22 00 00.
- 1.7 INTENT OF RESPONSIBILITY:
- A. It is the intent of this specification to provide for vibration isolation supports for all equipment, and piping as set out below. The transmission of perceptible vibration, structural borne noise, or objectionable air borne noise to occupied areas by equipment installed under this contract will not be permitted. The Contractor shall be held responsible for installing the vibration isolators as specified herein or shown on the drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas. The isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria, and one which can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.
 - B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier who will be responsible for adequate coordination of all phases of this work. Concrete housekeeping pads and inertia bases shall be included as part of plumbing work. The concrete work shall meet the requirements specified in the General Contract Specifications.

- C. The Contractor shall furnish complete submittal data, including product schedule, which shall indicate the size, type, and deflection of each isolator; and the supported weight, disturbing frequency, and efficiency of each isolator proposed; and any other information as may be required for the Architects and Engineers to check the isolator selection for compliance with the specification. All steel bases and concrete inertia bases shall be completely detailed, and shall show completely any reinforcing steel that may be required to provide a rigid base for the isolated equipment. Further, the submittal data shall indicate, clearly, outlined procedures for installing and adjusting the isolators and bases mentioned above.
- D. The vibration isolation manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be required to assure correct and complete installation and adjustment of the isolators. Any discrepancies or maladjustments found shall be so noted in the report. Should any noise or vibration be objectionable to the Owner, Architect or Engineer, a field instrumentation test and measurement must be made to determine the source, cause, and path of any such disturbance. Any variation or noncompliance with these specification requirements is to be corrected by the installing contractor in an approved manner.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN FEATURES:

- A. Vibration isolation devices shall be as manufactured by Amber/Booth Company, Consolidated Kinetics, Korfund Dynamics Corporation, or approved equal.
- B. All vibration isolators and bases furnished by the Contractor shall be designed for and treated for resistance to corrosion.
- C. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc-electroplated or cad-plated. Structural bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
- D. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized or zinc-electroplated plus coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel.
- E. Required spring deflections for isolators supporting various items of equipment are shown on the Drawings or tabulated elsewhere in these specifications, but in no case shall be less than one inch. The springs shall be capable of 30% over-travel before becoming solid.
- F. Where height-saving brackets for side mounting of isolators are required, the height-saving brackets shall be designed to provide for an operating clearance of 2" under the isolated structure, and designed so that the isolators can be installed and removed when the operating clearance is 2" or less. When used with spring isolators having a deflection of 2-1/2" or more, the height-saving brackets shall be of the pre-compression type to limit exposed bolt length between the top of the isolator and the underneath side of the bracket.
- G. All isolators supporting a given piece of equipment shall limit the length of the exposed adjustment bolt between the top and base to a maximum range of 1" to 2".
- H. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.
- I. Isolators for equipment installed out-of-doors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind load of 55 PSF (pounds per square foot) applied to any exposed surface of the equipment without failure.

2.2 ISOLATOR TYPES:

- A. Isolator types and required deflections are specified under "Schedule of Isolated Equipment," paragraph 3.02. The isolators shall comply with the following descriptions for each type required on the project:

- B. Type 1 - An elastomeric mounting having steel base plate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric materials. The elastomer may be Neoprene or high synthetic rubber with anti-ozone and anti-oxidant additives. Mountings shall be designed for approximately 1/4" deflection and loaded so that deflection does not exceed 15% of the free height of the mounting.
- C. Type 2 - A pad-type mounting consisting of two layers of 3/8" thick, ribbed or waffled, Neoprene pads bonded to a 16 gauge galvanized steel separator plate. Bolting not required. Pads shall be sized for approximately 20 to 40 psi load, or a deflection of 0.10" to 0.16".

2.3 FLEXIBLE PIPING CONNECTIONS AT PUMPS:

- A. Unit should be rated at 225 psi and a maximum temperature of 230°F.
- B. Provide 150 lb. flanges and galvanized aircraft cable control units.
- C. Vacuum Pumps and Air Compressor Systems: Provide braided stainless steel hose with bronze solder type end connectors, rated for a minimum 150 psi pressure for compressed air and vacuum service of a minimum of 189 Hg. Manufactured by Mason Industries or approved equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

- A. Install vibration isolators for motor driven equipment.
- B. Set steel bases for 1-inch clearance between housekeeping pad and base. Set concrete inertia bases for 2-inch clearance. Adjust equipment level.
- C. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.
- D. Piping:
 - 1. Floor mounted supports shall have the same type of isolator or media as is used for the nearest isolated equipment connected to the piping.
 - 2. The pipe hanger system shall have provisions for all piping to be shimmed or blocked in place until all connections are made and the system filled with water; then, the isolators adjusted to support the weights, and the shim blocks removed.
 - 3. The first three support points from a piece of isolated equipment shall be of the positioning type and provide not less than the static deflection of the equipment isolators.
- E. Resilient Sleeves:
 - 1. Resilient sleeves shall be provided at all points where equipment room walls, floors, or ceilings are penetrated by piping.

3.2 SCHEDULE OF ISOLATED EQUIPMENT:

- A. Tabulated below is a schedule of equipment on this project requiring vibration isolation and base isolators of the types listed above. Any equipment, system, construction or condition that may be altered, added, or changed; or that is not specifically considered herein or on the plans shall be treated in a manner that is set out for similar equipment system or construction in order to comply with the above requirements heretofore cited.

Equipment Type	Isolator Type/Minimum Deflection (Inches)
Pumps up to 5 HP	Type 1-0.5"
Pumps 5 HP	Type 1-1"
Pumps 10 HP	Type 1-2"
Vacuum Pumps	Type 1-1"

END OF SECTION 22 05 48

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SECTION 22 05 53 – PLUMBING IDENTIFICATION

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
- 1.2 SECTION INCLUDES
- A. Nameplates
 - B. Tags
 - C. Stencils
 - D. Pipe Markers
- 1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION
- A. Section 22 63 13 – Medical Gas Systems: Supply of pipe labels for placement by this Section
- 1.4 RELATED SECTIONS
- A. Section 09 91 00 – Painting: Identification painting
- 1.5 REFERENCES
- A. ASME A13.1 – Scheme for the Identification of Piping Systems
- 1.6 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
 - C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
 - D. Product Data: Provide manufacturers catalog literature for each product required.
 - E. Samples: Submit two of each type of label, tag, etc., of the approximate size specified or implied in the specification.
 - F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- 1.7 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 22 00 00.
 - B. Record actual locations of tagged valves.

PART 2 - PRODUCTS

- 2.1 GENERAL
- A. The contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them. All items of equipment such as pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the drawings. For example, pumps will be identified as 3a, 3b, 3c, etc.

2.2 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Manufacturers:
 - 1. Seton Identification
 - 2. Brady Corporation
 - 3. Marking Services

2.3 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved blackletters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter
- B. Metal Tags: Brasswith stamped letters; tag size minimum 1-1/2 inch (40 mm) diameterwith smooth edges.
- C. Chart: Typewritten letter size list in anodized aluminum frame.
- D. Manufacturers:
 - 1. Seton
 - 2. Identification Products
 - 3. Brady Corporation
 - 4. Marking Services

2.4 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.
- D. Manufacturers
 - 1. Seton Identification Products
 - 2. Brady Corporation
 - 3. Marking Services

2.5 CEILING TACKS

- A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- B. Color code as follows:
 - 1. Green - Plumbing valves
- C. Manufacturers
 - 1. Seton Identification Products
 - 2. Brady Corporation
 - 3. Marking Services

2.6 PLUMBING EQUIPMENT

- A. Equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2" high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include but not be limited to the
 - Pumps
 - Compressors

2.7 PIPING: PIPE MARKERS AND ARROW MARKERS ALSO SHALL BE PROVIDED ON BUT NOT LIMITED TO THE PIPING OF THE FOLLOWING SYSTEMS:

		Sanitary Waste, Vent
Lab Air		
Lab Vacuum	Sanitary Vent	Domestic Hot Water Supply
Domestic Hot Water Return	Domestic Cold Water Supply	

2.8 VALVE TAGS:

- A. The Contractor shall provide and install identification tags lettered and numbered to correspond to the information shown on the charts described above. These tags are to be affixed to all valves except simple service and drain valves located within 10' and within sight of the device or equipment served. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. These tags shall be 1/8" thick brass discs, 1 1/2" in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.
- B. Valves at water headers PRV stations, valves associated with gas, water meters, and other valves as specified shall also be tagged with standardized color coded plastic tags. These tags shall be 2 1/2" wide by 1 1/2" high with these color codings: Red = normally closed; Green = normally open; Tags should be engraved on both sides.
- C. In addition, pipe runs throughout the building including those above lift out ceilings, under floor, and those exposed to view when access doors or access panels are opened shall be identified by means of Seton Setmark or Brady Mechanical Pipe Markers. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements. In addition to the pipe markers, arrow markers shall be used to indicate direction of flow. The following specific instructions shall apply to the application of these markers:
- D. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one header, it is necessary to mark only the header.
- E. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.
- F. Provide a double ended arrow marker when flow can be in either or both directions.
- G. Provide a pipe marker and an arrow marker at every point of pipe entry or exit where line goes through a wall or service column.
- H. Provide pipe markers and arrow markers at intervals not exceeding 50 feet.
- I. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
- J. Use snap-on type identification for all piping systems, 3/4" thru 6". For piping systems larger than 6", use strap on markers.
- K. Pipe Markers shall conform to ANSI A 13.1-1981 "Scheme for the Identification of Piping Systems." Arrow markers must have same ANSI background colors as their companion pipe markers, or be incorporated into the pipe identification marker.
- L. Locate markers to be visible from floor.

2.9 SPECIALS:

- A. Refer to special requirements noted in the various sections hereinafter bound.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 9 for stencil painting.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Division 9.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Identify pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Provide ceiling tacks to locate valves or other concealed equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 22 05 53

SECTION 22 07 19 – PLUMBING INSULATION

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. 22 00 00 -- Basic Plumbing Requirements
 - B. 22 05 29 – Plumbing Supports and Sleeves
 - C. 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Piping insulation
 - B. Jackets and accessories
- 1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
- A. Section 22 13 16- Plumbing Piping: Placement of hangers and hanger inserts.
- 1.4 RELATED SECTIONS
- A. Division 9 - Painting
- 1.5 REFERENCES
- A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate.
 - B. ASTM C177 Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
 - C. ASTM C195 Mineral Fiber Thermal Insulation Cement.
 - D. ASTM C335 Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - E. ASTM C449 Mineral Fiber Hydraulic setting Thermal
 - F. ASTM C518 Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - G. ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation.
 - H. ASTM C534 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - I. ASTM C547 Mineral Fiber Preformed Pipe Insulation.
 - J. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation.
 - K. ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation.
 - L. ASTM C585 Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - M. ASTM C921 Properties of Jacketing Materials for Thermal Insulation.
 - N. ASTM D1056 Flexible Cellular Materials Sponge or Expanded Rubber.
 - O. ASTM D2842 Water Absorption of Rigid Cellular Plastics.
 - P. ASTM E84 Surface Burning Characteristics of Building Materials.
 - Q. ASTM E96 Water Vapor Transmission of Materials.
 - R. NFPA 255 Surface Burning Characteristics of Building Materials.
 - S. UL 723 Surface Burning Characteristics of Building Materials.
 - T. ASHRAE 90.1 – Energy Standard for Buildings Except Low Rise Residential Buildings

1.6 SUBMITTALS

- A. Submit under provisions of Section 22 00 00.
- B. Product Data: Provide product description, list of materials 'k' value, 'R' value, mean temperature rating, and thickness for each service, and locations.
- C. Samples: When requested, submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

- A. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84 89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- B. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 22 00 00.
- C. All piping shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- D. To be considered, alternate materials shall have equivalent thermal and moisture resistance of the specified materials.

1.8 QUALIFICATIONS

- A. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation.
- B. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation. The company performing the work of this section shall have a minimum of three years' experience specializing in the trade.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 22 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product thermal ratings and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. All insulation materials to be asbestos free.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT AND COLD WATER

- A. All domestic hot and cold water lines in buildings, including valves, strainers, unions, flanges, etc., except where specifically noted to the contrary, shall be insulated.
- B. All domestic cold water lines shall be insulated as scheduled with preformed fiberglass insulation with a factory applied All Service Jacket, vapor sealing all joints, and factory performed fittings with vapor seal, or a flexible, "25-50" rated, closed cell elastomeric thermal insulation such as "Self Seal Armaflex 2000". Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping. Valves shall be insulated with mitered pipe covering with voids filled with glass fiber blanket insulation. Valves and fittings shall be vapor sealed with a water base asphaltic emulsion. Fittings on concealed insulation shall be built up to the thickness of adjacent insulation with glass fiber fitting wrap and shall be finished with Glasfab tape embedded in vapor barrier emulsion. Exposed fitting insulation shall be built up to same thickness as adjoining pipe insulation with one coat cement and after drying shall be finished with a white vapor seal and canvas jacket secured with "Arabol" adhesive and be suitable for painting. Seams in jacket shall be placed in the least noticeable locations. Where seams, joint or fittings are rough they shall be covered with an application of insulating cement troweled on smoothly before the canvas is applied with Arabol adhesive. The canvas must be free of wrinkles and have a smooth, neat appearance.
- C. All domestic hot water piping systems shall be insulated as specified above for cold water except the vapor barrier may be deleted and the lap and butt joints secured with staples and a field applied adhesive (self sealing lap and butt joints alone are not acceptable). The insulation thickness shall be as scheduled. Where service temperature exceeds 250°F, insulation shall contain high temp binders.
- D. The only domestic hot and cold water piping that will not require insulation is the exposed runouts under non-handicap plumbing fixtures. Where pipe chases are tight, adequate provision shall be made at the rough in stage utilizing offset fittings or other means (except springing the pipe) to insure that insulation can be applied throughout the length of the pipe.

2.2 CONDENSATE DRAINAGE AND WATER RECOVERY.

- A. All piping receiving condensate drainage and water recovery shall be insulated, as specified herein.

2.3 TYPE A: FIBERGLASS

- A. Owens Corning or equal glass fiber insulation piping insulation with a "K" factor of 0.23 BTU-In/Hr.-degree F at 75°F and 0.32 BTU-In/Hr.-degree F at 250°
 1. Rated maximum service temperature of 850°F.
 2. Maximum density of 3.5-5.5 lbs/ft³
 3. Compressive strength of 28.5 psi minimum when tested in accordance with ASTM C165.
 4. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
 5. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 6. Rated as noncombustible when tested in accordance with ASTM E136.
 7. Insulation treated with water resistant resin on the surface and within each layer of the insulation

2.4 TYPE B: CLOSED CELL ELASTOMERIC

- A. Closed cell elastomeric piping insulation with a "K" factor of 0.25 BTU-In/Hr.-degree F at as manufactured by Armacell or equal.
 1. Rated maximum service temperature of 220°F.

2. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
3. Certified to meet the requirements of ASTM C795 for use over stainless steel.
4. Rated as noncombustible when tested in accordance with ASTM E136.

2.5 PROTECTIVE JACKETING

- A. Aluminum Jacketing and fitting covers: 0.016 aluminum smooth as manufactured by Premetco or Childers. The jacket shall be pre-cut, pre-rolled, and lapped a minimum of two inches (2") in all directions to shed water. The metal shall be secured at each joint with a minimum of one each (1 ea.) 3/4" wide .020 aluminum or stainless steel band and seal. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.
- B. PVC Jacketing: Proto Corp. LoSmoke PVC jacketing and fitting covers. Material shall have 25/50 rating and shall be limited to piping systems operating at 140 degrees or below.

PART 3 - INSTALLATION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions in the absence of specific instruction herein.
- B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the "90°" position, with the seam lapped such that the lap is directed down.
- C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
- D. For insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For piping systems being heat traced, provide insulation one pipe size larger to accommodate the heat tracing cable.

3.3 INSERTS, SUPPORTS AND SHIELDS

- A. Application: Piping 3/4 inch diameter or larger for all systems.
- B. Shields: Install between pipe hangers or pipe hanger rolls and inserts. Hangers shall be on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe for insulated pipes 3/4" and larger. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe. Shields shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint. Required metal shield sizes are as follows:

Nominal IPS	Metal Thickness of Shield	Lengths
up thru 2"	14 gauge	12"
thru 6"	12 gauge	16"
and above	10 gauge	20"

- C. Insert Location: Between support shield and piping and under the finish jacket.
- D. Insert Configuration: Minimum 2” inches longer than length of shield, of same thickness and contour as adjoining insulation; may be factory fabricated.
- E. Insert Material: Heavy density insulating material suitable for the planned temperature range, and the weight of the pipe.
- F. The shields at support points shall be secured with ½” x 0.016” stainless steel bands and seals.
- G. Finish insulation at supports, protrusions, and interruptions.
- H. In lieu of the above the following system of support may be used:
 - 1. At the pipe support positions, the insulation and vapor barrier shall be continuous and shall not be punctured by the support. The insulation at the support shall be the full circumference of 5lbs/ft³ INSUL-PHEN Foam material to withstand the bearing loads transmitted from the pipe to the support, it shall extend for at least 1" on either side of the support to allow sealing of the joints with the pipe insulation jacket.
 - 2. The load bearing insulation at the support shall be capable of withstanding the maximum static compressive loads generated by pipe supported at the centers shown in Table Variations: Pipe loads greater than those generated at the support centers shown in Table 1 shall be referred to the manufacturer to establish the length and density of the insulated support block. The support centers are based on the weight of Sch 80 pipe filled with water and covered with 1" thickness of 2.2 lbs/ft³ standard insulation including FSK/ASJ vapor barrier.
- I. Table 1 K Block Support Centers

Nominal Pipe Size	3/4	1	1 1/4	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24
Max support centers (feet)																
Sch 80 pipe filled with water covered with 1" of Standard Insulation	6.5	6.5	6.5	10	10	10	10	10	14	14	14	20	20	20	20	20
Metal Saddle Gauge (Galvanized Steel)	22	22	22	20	20	20	16	14	14	14	14	14	114	14	14	14
Length of K Block (inches)	6	6	6	6	6	6	6	9	9	9	9	9	9	12	12	12

- 1. The Insulation at supports shall be a Kooltherm K Block. K Blocks shall be faced with factory applied FSK/ASJ vapor barrier and fitted with a galvanized steel 1800 saddle bonded to the bottom section of the K Block, for all pipe sizes 1 1/2" and larger.
- 2. The vapor barrier shall be completed by the use of a FSK/ASJ overlap and factory applied self-seal lap tape and sealed with vapor barrier adhesive.
- 3. At all support positions, other than those where the insulated pipe support block is surrounded by a clip or saddle in direct contact with the block, a block designed to accept the loads generated by the pipe shall be presented to the engineer for approval. e.g. Of the type Kooltherm products K Block. Ref:-Kooltherm sketch 106/2c for use with Roller or flat beam support.
- 4. In all cases where roller supports are used the length of the insulation and the wearing plate where fitted shall extend beyond the limits of the pipe movement.
- J. For purpose of definition in this Specification: “concealed” areas are those areas which cannot be seen by the building occupants, and “exposed” areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- K. Self-Sealing Lap and butt joints will not be acceptable as the only seal on piping insulation joints. Self Sealing Lap and butt joints may be utilized only if the joints are additionally secured with field applied vapor barrier adhesive (on piping Systems requiring vapor barriers) or staples and field applied adhesive (on piping system which do not require a vapor barrier jacket). Mechanical fasteners shall be used whenever possible to assure permanent installation.

- L. Insulation minimum thickness shall be as scheduled; however, additional thickness shall be provided to prevent condensation on the cold surfaces and to provide a maximum exterior insulation surface of 140 degrees F on the hot surfaces.
- M. All insulated piping in the mechanical rooms within 8'-0" of the floor shall be encased in an aluminum protective jacket, and where applicable, finish at top with nickel-plated brass flange plate with set screws or end joint sealing butt strips.
- N. All piping with crawl space, outside building and in tunnels shall be protected with an aluminum jacket.

3.4 PAINTING

- A. All exposed insulation shall be prepared to receive painting specified under Section 09 91 00.

3.5 INSULATION APPLICATION SCHEDULE

- A. Where minimum scheduled thickness exceeds the thickness required to meet the minimum R-Value, provide the minimum scheduled thickness.

<u>Service</u>	<u>Pipe Diameter Inches</u>	<u>Location</u>	<u>Fluid Temp Degrees F</u>	<u>Min. R-Value</u>	<u>Insulation Type and Thickness in Inches</u>	
					<u>Type A</u>	<u>Type B</u>
Domestic Cold Water And Makeup Water	All Sizes	Interior	Ambient	4.2	<u>Type A</u> 1	<u>Type B</u> 1
Domestic Cold Water	All Sizes	Interior, Serving Single Fixtures	Ambient	2.1	<u>Type A</u> 1/2	<u>Type B</u> 1/2
Domestic Hot Water Supply & Return	1 to 1-1/4	Interior	105-140	4.2	<u>Type A</u> 1	<u>Type B</u> 1
Domestic Hot Water Supply & Return	1-1/2 and up	Interior	105-140	6.4	<u>Type A</u> 1-1/2	<u>Type B</u> 1-1/2
AHU Drains	All Sizes	Interior	Ambient	4.2	<u>Type A</u> 1	<u>Type B</u> 1
Drinking Fountain Drains	All Sizes	Interior	40-55	4.2	<u>Type A</u> 1	<u>Type B</u> 1

1. All insulation R-Values shall be the greater of what is scheduled above or required to meet ASHRAE 90.1-2013.
2. Minimum 'R' does not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation under extreme conditions.
3. A minus 15 percent tolerance, on the insulation performance listed shall be permitted for manufacturers' standard insulation systems.
4. In non-conditioned mechanical rooms and all crawl spaces, insulation shall prevent formation of surface condensation under conditions of 95°F, 95%RH, and zero wind speed. Provide manufacturer's certification of this performance on submittal data.

END OF SECTION 22 07 19

SECTION 22 11 23 – PLUMBING EQUIPMENT

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Packaged Water Heating Systems
 - B. Pumps
- 1.3 RELATED SECTIONS
- A. Section 22 05 48 - Vibration Isolation
 - B. Section 26 05 19 - Insulated Conduits: Electrical characteristics, cable, wire, materials
 - C. Section 26 27 26 - Wiring Devices: Wiring connections
- 1.4 REFERENCES
- A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design
 - B. ASME Section VIII - Pressure Vessels; Boiler and Pressure Vessel Codes
 - C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code
 - D. ANSI/NFPA 54 - National Fuel Gas Code
 - E. ANSI/NFPA 58 - Storage and Handling of Liquefied Petroleum Gases
 - F. ANSI/NFPA 70 - National Electrical Code
 - G. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters
 - H. ANSI/UL 174 - Household Electric Storage Tank Water Heaters
 - I. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum)
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Shop Drawings:
 - 1. Include heat exchanger dimensions, size of tapings, and performance data.
 - 2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.
 - C. Product Data:
 - 1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements, and affected adjacent construction.
 - 3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.

- D. Manufacturer's Installation Instructions.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 00.
- B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Texas Department of Health Standards.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 1. American Gas Association (AGA).
 2. National Sanitation Foundation (NSF).
 3. American Society of Mechanical Engineers (ASME).
 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 5. National Electrical Manufacturers' Association (NEMA).
 6. Underwriters Laboratories (UL).
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 10 percent of midpoint of published maximum efficiency curve.

1.8 REGULATORY REQUIREMENTS

- A. Conform to AGA, NSF, ANSI/NFPA 54, ANSI/NFPA 58, ANSI/NFPA 70, ANSI/UL 174, and ANSI/UL 1453, as appropriate, requirements for water heaters.
- B. Conform to ASME Section VIII for manufacture of pressure vessels for heat exchangers.
- C. Conform to ASME Section VIII, ANSI/NFPA 30, or ANSI/NFPA 31 for tanks.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 WARRANTY

- A. Provide five-year warranty under provisions of Section 22 00 00.
- B. Warranty: Include coverage of domestic water heaters, water storage tanks, packaged water heating systems, in-line circulator, submersible sump pumps, sump pumps, sewage ejectors.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATERS

- A. Provide commercial type electric powered water heater with integral storage tank compliant with UL 1453. Unit shall be UL listed pre-wired, factory tested complete with tank drain valve and ASME rated temperature and pressure relief valve. Refer to drawings for recovery rate, storage capacity, electrical demand and dimensions.
- B. Storage tank shall be constructed to Section 4 of ASME Code for 125 psi working pressure. Storage tank shall be internally glass lined with high density magnesium anodic protection. The tank shall be factory insulated with fiberglass insulation with enamel steel jacket to meet the thermal efficiencies of ASHRAE 90A.

- C. The water heater shall have a 120 volt control circuit powered by fused transformer, immersion temperature control adjustable through a range of 60 degrees F to 180 degrees F, with a manual reset high temperature cut-off switch and temperature limiting device with automatic reset.
- D. Provide water heaters as manufactured by Lockinvar, A.O Smith, Bradford White, Rheem or State.

2.2 DOMESTIC HW CIRCULATION PUMPS

- A. These pumps shall be Bell and Gossett, Taco or Grundfos (magnetic coupled) having a circulating capacity as shown on the Drawings. Pumps shall be all bronze construction. Furnish for the control of each pump an Allen Bradley Bulletin 600 Toggle Switch with thermal overload protection and pilot light.
- B. Provide electronic timer to control run cycle of circulation pump to cut off pump during periods of building not being occupied for energy conservation. Timer shall be field adjustable, 24 hour a day operation and set point, to cut on/off pump during night, 120 volt single phase, with manual external override, drawn steel case, hinged door, battery backup, UL listed, set points as indicated on the construction drawings. Manufactured by Intermatic Model EH10, or approved equal.
- C. Provide aquastat to control on/off function of circulating pump based on required temperature setting of the domestic hot water circulation system, during periods of when timer has not cut off pump. Aquastat shall be pipe mounted with immersion insertion element, single type, field adjustable temperature setting, SPDT type switch, 120 volt single phase power requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, and state requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Install the water heaters, piping, vents and accessories in accordance with the manufacturer's published installation instructions.
- D. Furnish all supports required by the equipment included in this Contract.
- E. Provide a 4" thick, reinforced concrete housekeeping pad beneath heaters and pump skids.
- F. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
- G. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
- H. Provide a temperature gauge in the domestic hot water piping within five feet of outlet of each heater, upstream of all shut-off valves. Size and locate gauge to be easily readable from a standing position.
- I. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- J. Pipe relief valves discharge and all equipment drains indirectly to appropriate floor drain.
- K. Set the equipment operating and safety controls.
- L. Set thermostats on domestic water heaters to deliver maximum water temperature as indicated on Contract Drawings.
- M. Coordinate equipment electrical connections with Division 26 requirements. Ground equipment and connect wiring according to Division 26 specified requirements.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids.

END OF SECTION 22 11 23

SECTION 22 13 16 – PLUMBING PIPING

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Pipe and Pipe Fittings
 - B. Valves
- 1.3 RELATED SECTIONS
- A. Section 33 13 00 – Disinfection of Water Distribution System
 - B. Section 08 31 13 – Access Doors
 - C. Section 09 91 00 – Painting
 - D. Section 22 20 00 – Piping, Valves and Fittings
 - E. Section 22 05 48 – Plumbing Vibration Isolation
 - F. Section 22 07 19 – Plumbing Insulation
 - G. Section 22 11 23 - -Plumbing Equipment
 - H. Section 22 13 17 – Plumbing Specialties
 - I. Section 22 40 00 – Plumbing Fixtures
- 1.4 REFERENCES
- A. See Section 22 20 00
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 22 00 00.
 - B. Record actual locations of valves, etc., and prepare valve charts.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 22 00 00.
 - B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.8 QUALITY ASSURANCE
- A. See Section 22 20 00

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum of three years documented experience.

1.10 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with International Plumbing Code.
- B. Conform to applicable code for installation of backflow prevention devices.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.13 EXTRA MATERIALS

- A. Furnish under provisions of Section 22 00 00.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Provide materials as specified herein and indicated on Contract Drawings. All materials and work shall meet or exceed all applicable Federal and State requirements and conform to adopted codes and ordinances of authorities having jurisdiction.
- C. Pressure ratings of pipe, fittings, couplings, valves, and all other appurtenances shall be suitable for the anticipated system pressures in which they are installed.

2.2 SANITARY DRAINAGE SYSTEM

- A. General: The sanitary drainage system shall be installed as indicated on the Drawings complete with all fixtures, drains, traps and required connections. All fixtures and drains shall be properly vented and trapped. The Contractor shall complete the installation of the sanitary drainage system by making approved connections as indicated on the Drawings.
- B. Pipe and Fittings:
 - 1. All pipe used for interior, above ground sewer and drainage purposes, unless specifically shown to the contrary, shall be service weight cast iron soil pipe. All pipe and fittings shall be service weight cast iron marked with collective trade mark of CISPI. Manufactured by Charlotte, Tyler or AB & I.

2. All pipe and fittings from the sump pumps and sewage ejectors shall be Schedule 80 PVC with PVC bolted flange connections at pump discharge and at each valve. PVC piping shall be run from the pumps to the exterior piping connection point within 6" of 5'-0" outside of the building.
 3. Galvanized or black steel pipe shall not be used in any waste connection to a fixture or in any section of the soil or waste piping system.
 4. All underground sanitary waste piping, of all sizes, shall be cast iron hub and spigot type, with Tyseal (or approved equal) neoprene gaskets. Hubless piping systems shall not be used in a directly buried, underground application.
- C. Installation of Piping:
1. All piping shall be run in the most direct manner. Horizontal pipes shall have a grade of one-quarter inch (1/4") per foot, wherever possible, and not less in any case than one-eighth inch (1/8") per foot, unless otherwise noted on Drawings.
 2. Cleanouts shall be provided at the bottom of each riser, at each change of direction and at intervals not exceeding 95 feet in horizontal runs. Interior cleanouts shall be brass caulked into the lines, and where they occur in walls or floors of finished areas, shall be provided with nickel-bronze tops or access plates. All interior cleanouts shall be of the same size at the pipe served up to four inch (4") size and four inches (4") for all larger lines.
 3. Exterior cleanouts shall consist of a concrete encased wye in the line with sewer pipe extending upward therefrom and terminating in a concrete slab below grade. A standard cast iron cleanout casting shall be set on this slab in such manner as to be flush with finished grade and to provide access through its cover to the cleanout. A removable concrete stopper shall be set in the open top of the cleanout pipe.
- D. Flashings: All vent pipes passing through the roof shall be provided with roof flashings per Section 22 05 29.
- E. Testing:
1. After the vertical lines of soil pipe, waste, and other parts of the sanitary system have been set from the basement to the top of the building, all outlets shall be temporarily "plugged up", except as are required for testing as described herein. One floor level of the building shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
 2. A final test shall be conducted after all vertical and horizontal pipes and "rough-ins" have been complete but before the sewer connection is made. The test procedure shall be identical with that described above except that the entire plumbing system, i.e., the vertical and horizontal pipe and "rough-in", shall be subjected to water under the head imposed by filling the system to the top of the building for buildings two (2) stories and less. For buildings more than two stores, the Contractor can test two stories at a time or use compressed air to test the system, set at 5 psi test pressure. After all testing operations have been completed, all waste lines shall be cleaned.
 3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.
- F. Fabrication Methods for Sewage and Drainage Pipe Lines:
1. Install promptly all sewers, drains and piping after excavating, chasing or cutting for them has been done to keep the openings for such piping open as short a time as possible. No piping shall, however, be permanently closed up, furred in or covered before the examination of same by the authorities having jurisdiction.

2. Waste pipes shall be sized to conform to the sizes indicated on the Drawings. Under no circumstances shall any drain line be smaller than two inches. The waste pipes from water closets shall not be smaller than four inches.
3. The drilling and tapping of soil or waste lines or the use of saddle joints or the welding or brazing of hubs or pipe to any soil, waste or vent lines is prohibited.
4. Wastes must be brought up directly in back of each fixture. Horizontal branch arms of lead or brass will not be allowed.
5. No waste or soil lines shall enter the vertical part or heel of a lead or cast iron closet bend. Waste lines may enter the horizontal part of the lead or cast iron closet bend. No sink or lavatory waste line shall enter any other waste line of two inch (2") size.
6. All waste connections shall be made of heavy brass threaded nipples or with copper tube with appropriate screw to sweat adapters for connecting to sanitary tee. All fixtures used in connection with the conveying of any waste substance to the sanitary sewer, shall be connected by means of a trap, waste and overflow. Slip joints will be permitted only on the house side of the trap, waste and overflow, or appliance which has such slip joints embodied in their original manufacture. Fixtures which have waste opening connected to the soil or waste lines by the use of bolts or screws shall have such connections made by the use of the exact number of bolts or screws as provided for in their original manufacturer.
7. Where waste and vents are exposed at fixtures, pipes shall be chrome plated brass or brass W.C.P. cover (iron pipe size) and shall have chrome plated escutcheons where they pass through floors, walls, or ceilings.

G. Vents:

1. Vent pipes shall be carried up adjoining soil and waste pipes, and they shall be connected into the main stack at top and bottom as indicated on the plumbing riser diagrams on the Drawings.
2. Vent pipes shall be of hubless service weight cast iron pipe.
3. All vent lines shall be so constructed that they cannot be used for waste or soil lines. No fixture shall be double trapped.

H. Connections to Floor Mounted Water Closets:

1. All connections for floor mounted water closets and waste piping shall be made with an appropriate cast iron closet flange and wax gaskets.

2.3 INTERIOR DOMESTIC WATER PIPING SYSTEMS:

A. All piping within confines of building walls shall be a part of the interior water piping system. Interior domestic water piping material and installation shall be as specified in the following paragraphs.

B. Pipe:

1. Interior domestic water piping larger than six inches (6") shall be Schedule 40 galvanized steel pipe. See Section 22 20 00. When approved by the Owner in writing, the use of roll-grooved copper pipe may be used. When a roll grooved coupling system is approved for a copper piping system, the couplings shall be ductile iron conforming to ASTM A-536 Grade 65-45-12, coated with copper colored alkyd enamel, similar to Victaulic Style 607. Coupling gaskets shall be Grade "EHP" EPDM compound for operating temperatures of -30 degrees F to 250 degrees F. Flange adapters for copper tubing shall consist of ASTM A-536, Grade 65-45-12 ductile iron housing with copper colored alkyd enamel. Flange adapters shall be manufactured for engaging directly into copper tubing sized roll grooved copper tube and fittings and bolting directly to ANSI Class 125 or Class 150 flanged components, manufactured by Victaulic Style 641.
2. Unless otherwise shown on the Drawings, all interior domestic water piping four inches (4") and smaller shall be fabricated of Type K, hard drawn, copper pipe made of deoxidized copper (99.9% pure). See Section 22 20 00. No pipe smaller than three-fourths inches (3/4") shall be used in this project except at local connections or as detailed for laboratory areas.

C. Fittings: See Section 22 20 00.

D. Headers:

1. Suitable headers of the nature detailed on the accompanying Drawings shall be provided for the distribution of the cold water systems. These headers shall be fabricated by a fusion welding process by the use of extra strong black steel pipe and fittings of the same character. All flanges used in the case of such headers shall be dimensioned, faced, drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings (B16e-1939). The header outlets shall be effected by welding to the header full length welding couplings of the proper size. These header outlets shall be carefully aligned to be "square" and parallel.
2. Upon being completed, these headers shall be subjected to a hydrostatic test of 300 pounds per square inch gauge. All defects noted upon inspecting the headers thus tested shall be repaired by chipping, machining and burning out defects, and re-welding. After repairs have been made, the headers shall be retested as described above.
3. After the headers have been tested and found to be tight, they shall be galvanized by a "double-dip" process. The manufacturer shall be required to provide certificates assuring the fact that the headers were so "double-dipped". Both exterior and interior surfaces shall receive a heavy zinc coating by a hot dipping process. Galvanized steel nipples shall be used to extend the various header outlets to the valves placed in each outgoing water line near the header. These nipples shall be of such a length that the valves in the outgoing water lines are neatly lined up in a horizontal plane. At a point just beyond these valves, a three-fourths inch (3/4") valved drain line shall be installed in each outgoing branch leaving the header. The purpose of such valve branches shall be to drain the system into which the flow of water is controlled by the valves previously mentioned. These three-fourths inch (3/4") drain line valves from the various branches leaving the headers shall be likewise lined up in a straight horizontal line. These three-fourths inch (3/4") drain lines shall terminate in a common "drain line". That one inch (1") drain line shall be the header drain line. Headers fabricated from copper pipe and roll grooved fittings may be substituted only with the written approval of the Owner.

E. Cross Connections:

1. Care shall be exercised in fabricating plumbing lines to avoid all cross connections and to construct the piping systems in a manner which eliminates the possibility of water contamination.
2. The piping systems have been designed in every case to avoid the possibility of reverse flow or back siphoning. Care shall be exercised in constructing plumbing lines to make certain that not only the letter, but the spirit, of these safety precautions is carried out to the fullest possible extent.

F. Requirements of Interior Water Piping Systems:

1. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.
2. All exposed chrome plated, polished or enameled connections from fixtures shall be put up with special care, showing no tool marks or threads at fittings, and supported by neat racks or hangers with round head screws of same material and finish.
3. The fabrication of copper pipe and fittings shall in every detail conform to the recommendations and instructions of the fitting manufacturer. The tools used shall be the tools adapted to that specific purpose.
4. Refer to other parts of this Section and Section 22 00 00 and 22 20 00 for other information concerning installation of piping.

G. Testing and Sterilization:

1. All water piping systems shall be properly tested to assure their being absolutely tight. In the case of pipes which are to be insulated, these tests shall be completed and the piping system proven to be absolutely tight before any insulation is applied. Wherever pipes are placed so that they will ultimately be concealed, these tests shall be conducted and the absolute tightness of each piping system shall be demonstrated before the system is concealed.
2. The procedure of these tests shall consist of subjecting a piping system to a hydrostatic pressure per Section 22 00 00. During the test period, all pipe, fittings and accessories in the particular piping system which is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped by means designated by the Owner's duly authorized representative and the hydrostatic test shall again be applied. This procedure shall be repeated until, for an entire twenty-four hour period, no leaks can be found while the system being tested is subjected to the pressure mentioned above.

3. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five (5) days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period. Even though the completion of these tests is satisfactory, there is a continuing responsibility for the ultimate, proper, and satisfactory operation of such piping systems and their accessories.
4. The sterilization process shall be conducted as required by the Health Department of the City Houston, and the specifications above, and upon completion of the process, the Health Department shall test and certify the cleanliness of the water piping system. The Mechanical Subcontractor shall pay all costs and charges incidental to this test and certification.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations under provisions of Section 22 00 00.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- H. Establish elevations of buried piping outside the building to ensure a minimum of cover. Refer to Section 22 00 00.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Install bell and spigot pipe with bell end upstream.
- L. Install valves with stems upright or horizontal, not inverted.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe or plug valves for throttling, bypass, or manual flow control services.

- E. Provide spring loaded check valves on discharge of water pumps.
- F. Provide flow controls in water recirculating systems where indicated.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean. After completion of the testing, the entire cold and hot water piping systems, with attached equipment, shall be thoroughly sterilized.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 EQUIPMENT CONNECTIONS

- A. Under this section, water lines shall be run to and connected to the pumps, quick fills, and other items of equipment as indicated. Provide suitable shutoff valves, check valves, and, if required by the drawings, bypass valves at each and every such point of connection.

3.8 CONNECTIONS FOR GENERAL CONTRACTOR FURNISHED EQUIPMENT

- A. Route lines as indicated on the Drawings to serve various items of equipment specified elsewhere. Rough-in accordance with detailed drawings furnished by the equipment supplier, and make final connections to the equipment when it is installed. Rough-in shall terminate where noted on Drawings. All pressure lines shall be provided with shutoff valves or cocks. Drain lines shall be provided where required. It shall be assumed that the equipment supplier will provide and install valves and pipe specialties, etc. only as specified herein or called for on the Drawings.
- B. Laboratory and/or other special equipment and trim are specified in another section under which the equipment shall be furnished and installed. Trim, sink strainers and tail pieces shall be furnished only as indicated to the contractor who shall receive, store and install them. In addition, furnish the sink P-traps and all materials and labor to rough-in and make final connections.

3.9 CONNECTIONS FOR OWNER FURNISHED EQUIPMENT

- A. The Owner will be furnishing various pieces of equipment. The Contractor shall provide the rough-in indicated on the Drawings. Final connections are also included as part of this contract.

END OF SECTION 22 13 16

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SECTION 22 13 17 – PLUMBING SPECIALTIES

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Basic Plumbing Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Floor Drains
 - B. Cleanouts
 - C. Backflow preventers
 - D. Water hammer arrestors
 - E. Expansion tanks
- 1.3 RELATED SECTIONS
- A. Section 01 11 00 - Summary of Work
 - B. Section 22 13 16 - Plumbing Piping
 - C. Section 22 40 00 - Plumbing Fixtures
 - D. Section 22 11 23 - Plumbing Equipment
- 1.4 REFERENCES
- A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers
 - B. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent
 - C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle
 - D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types
 - E. ANSI A112.21.1 - Floor Drains
 - F. ANSI A112.21.2 - Roof Drains
 - G. ANSI A112.26.1 - Water Hammer Arrestors
 - H. ASTM C478 - Precast Reinforced Concrete Manhole Sections
 - I. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types
 - J. PDI WH-201 Water Hammer Arresters
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
 - C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
 - D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.
 - E. Manufacturer's Certificate: Certify that oil interceptors meet or exceed specified requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 22 00 00.
- B. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 00.
- B. Operation Data: Indicate frequency of treatment required for interceptors.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

1.9 EXTRA MATERIALS

- A. Furnish under provisions of Section 22 00 00.
- B. Provide two loose keys for each type of manhole cover and valve box.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS:

- A. Floor drains (F.D.) shall be sized to conform to the information indicated on the Drawings or contained elsewhere in these Specifications. Extreme care shall be used to set the elevation of the drain to meet the low point elevation of the finished floor. Each floor drain shall be provided with a P-trap unless noted otherwise. Note that a deep seal type trap may be required under other Sections of these Specifications.
- B. All floor drains will be furnished and installed with all accessories required for the particular construction in which they are to be mounted; and shall be as manufactured by Wade, Jay R. Smith, Mi-Fab or Zurn.
- C. Floor Drain (In Finished Areas) Type A (FD 1): Wade No. 1100-AX, cast iron floor drain with integral reversible clamp device, caulk device, caulk outlet and 6" round adjustable nickel brass strainer, acid resistant coating, and ½" plugged trap primer tap.

2.2 CLEANOUTS:

- A. At each change in direction, at the end of each continuous waste line, at the foot of each riser in the building and at 50' intervals in long horizontal runs, of lines of four inch (4") size and smaller, and not more than 95' intervals for larger lines, cleanouts shall be placed in soil and waste lines. The size of the cleanouts shall be identical with the size of the soil or waste line in which they are placed for four inch (4") and smaller lines. The size of cleanouts in lines larger than four inches (4") shall be six inches (6") in all cases. All cleanouts shall be placed to be easily accessible for servicing. Where they occur in pipe chases, they shall be placed above the floor in such a location so they will be easily accessible through access doors, or they shall be brought through the walls and be provided with covers. All horizontal soil and waste lines shall have a cleanout placed in the end of the line by the use of a wye and a 1/8 bend, or by a combination tee-wye and made easily accessible by extending the cleanout through the wall and be covered as described above. The screw plug of all cleanouts shall be of cast brass.
- B. All cleanouts shall be manufactures by Wade, Zurn, J.R. Smith, Mi-Fab or Josam. The specified manufactures and model number is the basis of design and the other listed manufacturers may be used, but must be equivalent to specification.

- C. Finished Walls. Primer coated cast iron cleanout tee with countersunk head, taper treaded bronze plug, No-Hub connections and 6-inch diameter-smooth-stainless steel secured access cover with secured/vandal proof screw. Manufactured by, Wade W-8460, or approved equal as manufactured by Zurn, J.R. Smith, Mi-Fab or Josam.
- D. Unfinished Areas. Primer coated cast iron cleanout tee with countersunk head, taper thread bronze plug and No-Hub connections. Wade W-8560-MODIFIED for No-Hub connections-D. approved equal as manufactured by Zurn, J.R. Smith, Mi-Fab or Josam.

2.3 STRAINERS:

- A. Strainers 2" and smaller, Class 125 ASTM B62 Cast iron, screwed ends, No. 20 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap), rated for 250 psi working pressure, manufactured by Nibco No. T-751-A, or approved equal. Strainers 2 1/2" and larger, ASTM A126-B cast iron body, class 125, rated for 200 psi working pressure, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" and larger shall have stainless steel reinforcing bands at ends to prevent collapsing. Cast iron strainers shall have FDA approved internal lining for domestic water service, manufactured by Nibco No. F-721-A, or manufactured with equivalent model.

2.4 BACKFLOW PREVENTERS AND VACUUM BREAKERS:

- A. Atmospheric Vacuum Breakers: Full line size, manufactured of brass or bronze with full size orifice, dry guide out of the liquid pressure area and disc float closing vent with minimum flow. Manufactured by Watts Regulator, No. 188A Series, or equivalent model by Wilkins or Conbraco (Apollo).
- B. Pressure Type Vacuum Breaker: Full line size, with full size orifices, manufactured of brass or bronze with double poppet (check valve) stainless steel screen and vent. Manufactured by Watts Regulator, No. 90, or equivalent model by Wilkins or Conbraco (Apollo).
- C. Reduced Pressure Backflow Preventer (RPZ): Size as indicated on Drawings, bronze construction, rated for 175 psi, and shall include strainer, gate or ball valves based on size, pressure differential relief valve, check valves, test cocks, and relief vent and funnel drain. Unit shall meet the requirements of ASSE 1013, and AWWA, University of Southern California tested and approved. Manufactured by Watts Regulator No. LF-909, or by Wilkins or Conbraco (Apollo).
- D. Vacuum Relief Valve: 3/4 inch bronze with high temperature resisting disc, and disc guide located out of water. Tested up to 200 psi and 250°F and shall be open on a vacuum of not more than 1/2 inch of mercury. Manufactured by Watts Regulator No. N36g, or by Wilkins or Conbraco (Apollo).
- E. High hazard, anti-siphon, anti-spill, vacuum breaker designed for indoor applications, featuring bronze body, one-piece modular check valve and float assembly, stainless steel springs, bronze quarter turn ball valves at inlet and discharge, University of Southern California tested and approved. Manufactured by Watts No. LF 008QT, or by Wilkins or Conbraco (Apollo).
- F. Double Check Valve Assembly: For sizes up to 2 inches provide lead free cast copper silicon alloy body with threaded end connections, with replaceable seats and seat discs, top mounted ball valve test cocks. Unit shall meet the requirements of ASSE 1015, AWWA c510, University of Southern California testes and approved, manufactured by Watts model (FOD) or equivalent model by Wilkens or Combraco (Apollo). For sizes over 2 inches provide lead free unit with epoxy coated cast iron body with stainless steel seats, flanged and connections, complete with gate valves on inset and discharge. Unit shall meet the requirements of ASSE 1015, AWWA C510-92, CSA B 64.5 and University of Southern California tested and approved, manufactured by Watts Model LF 709 or by Wilkins or Conbraco (Apollo).

2.5 TRAP PRIMERS:

- A. Electronic Type: Electronic trap priming manifold, surface mounted, complete with resettable timer, factory assembled, pre-piped bronze body, 1/2" inlet and water connection, solenoid valve, Type "L" copper manifold with brass 1/2" compression fittings with single point 120 volt electrical connection with manual override switch, 16 gauge steel enclosure with door and integral atmospheric vacuum breaker, with mounting anchors, manufactured by PPP Inc., "Prime Time" or approved equal.

2.6 EXPANSION TANKS:

- A. ASME coded pre-charged hydro pneumatic steel expansion tank, constructed with a maximum working pressure of 150 psig. Internal wetted parts shall be compliant with FDA regulations and approvals. Internal butyl diaphragm isolating water from air, 50 gallon by Amtrol "Therm-X-Trol" Model No. _____, or by Watts or Taco.

2.7 WATER HAMMER ARRESTORS:

- A. Provide hydraulic shock water hammer arrestors in domestic cold water and domestic hot water lines to each individual plumbing fixture or battery of fixtures, and at each automatic solenoid operated or quick closing valve serving equipment. Shock water hammer arrestors shall be of seamless type "K" copper body construction or type 304 stainless steel body with stainless steel bellows, nitrogen and helium gas pre-charged. Shock arrestors shall be certified to ASSE 1010-2004 Standard and listed with IAPMO, completely sealed and operating free of casing. Size all units according to water hammer arrestors standard PDI-WH-201. The shock arrestors shall have a life time warranty and shall be designed to provide continuous protection without maintenance allowing the shock arrestor to be installed without an access panel. Manufactured by Sioux Chief "Hydra-Rester", Wade or Jay. R. Smith.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.
- B. Verify location of equipment and housekeeping pads prior to installation of floor drains.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Pipe relief from back flow preventer to nearest drain.
- D. Install water hammer arrestors complete with accessible isolation valve and wall access panel where serving banks of plumbing fixtures. For single plumbing fixtures locate the water hammer arrestors above the ceiling with ceiling access panel. Where located above a lay-in ceiling, the ceiling access panel is not required.
- E. All backflow preventers shall be installed within the building.
- F. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then all of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and re-installed using all new materials.

END OF SECTION 22 13 17

SECTION 22 15 13 - COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 22 00 00 – Basic Plumbing Requirements
- B. Section 22 05 29 – Plumbing Supports and Sleeves
- C. Section 22 05 53 – Plumbing Identification

1.2 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Air Compressor
- C. Air Receiver and Accessories
- D. Aftercooler
- E. Air Dryer
- F. Pressure Reducing Station

1.3 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete
- B. Section 22 05 48 – Plumbing Vibration Isolation
- C. Section 22 13 16 - Plumbing Piping
- D. Section 26 05 19 - Insulated Conductors
- E. Section 26 27 26 - Wiring Devices

1.4 REFERENCES

- A. ASME - Boiler and Pressure Vessel Code
- B. ASME B16.3 - Malleable Iron Threaded Fittings
- C. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings
- D. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- E. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes
- F. ASME B31.1 - Power Piping
- G. ASME B31.9 - Building Services Piping
- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- I. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses
- J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- K. ASTM B32 - Solder Metal
- L. ASTM B88 - Seamless Copper Water Tube
- M. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings
- N. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe
- O. NFPA 70 - National Electrical Code

1.5 SUBMITTALS

- A. Submit under provisions of Section 22 00 00.
- B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.
- C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- D. Test Reports: Submit inspector's certificate for air receiver for inclusion in Operating and Maintenance Manuals.
- E. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, starting procedures.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 22 00 00.
- B. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 22 00 00.
- B. Operation Data: Submit for air compressor, air receiver and accessories, after cooler, air dryer, and pressure reducing station.
- C. Maintenance Data: Submit for air compressor, air receiver and accessories, after cooler, air dryer, and pressure reducing station.

1.8 REGULATORY REQUIREMENTS

- A. Conform to ASME codes for installation of pressure vessels.
- B. Provide certificate of compliance from Factory Mutual indicating approval of air receiver.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
- B. Accept air compressors, air dryer on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- C. Protect piping and equipment from weather and construction traffic.

1.10 WARRANTY

- A. Provide five-year warranty under provisions of Section 22 00 00.
- B. Warranty: Include coverage for air compressors, .

1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of 22 00 00.
- B. 2 air compressor inlet filter elements.
- C. 2 air compressor outlet (supply) filter elements.
- D. 2 air dryer inlet filter elements.
- E. 2 air dryer discharge filter elements
- F. 2 purge mufflers for air dryers.

PART 2 - PRODUCTS

2.1 COMPRESSOR MODULES:

- A. The compressors shall be belt driven oilless rotary scroll single stage, air cooled oilless construction with no oil needed for operation. The rotary design shall not require any inlet or exhaust valves and shall be rated for 100% continuous duty. Tip seals shall be of a composite PTFE material and be rated for 10,000 hours of operation. Compressor bearings shall be sealed, external to the air compression chamber, and shall be serviceable for extended compressor life. Bearing maintenance shall not be required until 10,000 run hours. Compressors with bearings that are not accessible for service are not acceptable. Compressors shall have an integral radial flow fan for cooling.
- B. Each compressor module shall have a piped intake manifold with one inline inlet air filter with isolation valve and a high inlet vacuum switch.
- C. Each compressor module shall be equipped with an integral air-cooled aftercooler designed for a maximum approach temperature of 15°F complete with automatic solenoid drain valve.
- D. Each compressor shall be equipped with a wired high discharge air temperature shutdown switch.
- E. The compressor module discharge line shall include a flex connector, safety relief valve, isolation valve and check valve. The discharge piping of each compressor module shall incorporate an integral valve to provide load-less starting and rapid air evacuation between the check valve and scroll discharge at shutdown to produce less than 1/4 revolution of reverse rotation of the scroll.
- F. Compressor motor shall be a NEMA rated, open drip-proof, 1800 RPM, with 1.15 service factor suitable for 460 volt, 60 hertz, 3 phase electrical service.
- G. Compressors shall be in a sound enclosure assembly.

2.2 AIR RECEIVER

- A. The air receiver shall be corrosion resistant, National Board Certified, Comply with Section VIII, Unfired Pressure Vessels, of the ASME Boiler and Pressure Vessel Code, be ASME Code stamped, and rated for a minimum 150 PSIG design pressure.
- B. The air receiver shall be of a capacity sufficient to prevent the compressors from short-cycling.
- C. The receiver shall be provided with a pressure indicator, liquid level gauge sight glass, safety pressure relief valve, manual drain valve, and a timed automatic solenoid drain valve.
- D. Air receiver shall be provided with a three-valve bypass to permit service to the receiver without shutting down the air system.

2.3 CONTROL SYSTEM

- A. The control system shall be NEMA 12 enclosure and U.L. labeled, factory pre-mounted and pre-wired.
- B. The control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each motor with external operators, full voltage motor starters with overload protection, and 120V control circuit transformers for each motor circuit.
- C. The control system shall include local visual and audible reserve unit alarm with isolated contacts for remote alarm, hand-off-auto lighted selector switches and runtime hour meters.
- D. Automatic alternation of the compressors shall allow equal division of operating time with provisions for simultaneous operation and automatic activation of reserve unit.
- E. Additional lag compressors shall automatically activate when compressors in operation are incapable of maintaining the required pressure.
- F. Local visual and audible alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm shall be included.
- G. A pressure gauge shall be provided in the control panel.

- H. Complete with dry contacts and a 4-20 Ma signal for remote monitoring to the DDC system for compressor status (indicating operation of any compressor is on), and compressor failure alarm (alarm upon only compressor failure).

2.4 AIR DRYER

- A. Air dryer shall be noncycling type refrigerated air dryer sized to provide 38°F dewpoint at 100 psig. Dryer includes on/off switch, control panel dewpoint indication, power cord, moisture separator with electric timer.
- B. FILTRATION/PRESSURE REGULATOR ASSEMBLY
 1. Consisting of single activated carbon filter with differential pressure gauge and change indicator.
 2. Single inline pressure regulator assembly consisting of pressure regulator with pressure gauge, inlet and outlet ball valves and pressure relief valve.

2.5 PIPING:

- A. Compressed air piping shall be ASTM Specification B280 or B819, Type K, hard drawn, seamless copper tubing factory cleaned sealed marked for oxygen service with wrought copper solder fittings complying with ANSI B16.22. All joints shall be brazed under a nitrogen purge. Cast copper alloy fittings shall not be permitted. No ferrous piping will be permitted in the system. Where threaded nipples are required these shall be I.P.S. brass.
- B. All piping shall be pitched back so as to drain to the point shown on the Drawings. All branch air take-offs shall be made from the top of the mains.
- C. All joining operations shall be done with pure dry nitrogen flowing through the pipe to prevent oxidation and scale information. During joining operations, nitrogen flow shall be verified by an oxygen sensor at the free end of the piping and by a pressure alarm on the nitrogen supply. When there are no active joining operations being performed, the system shall be securely sealed and maintained with a nitrogen charge in the sealed system. Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 538° F. Copper-to-copper joints shall be brazed using a copper-phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. Flux shall only be used when brazing dissimilar metals such as copper and bronze or brass, using a silver (BAG sense) brazing filler metal. Brazing alloy shall comply with ANSI/AWS A5.8.F. Straight-threaded connections, including unions, flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components shall not be permitted. Before erection, all pipe, tubing, valves and fittings (except those supplied expressly cleaned by manufacturer) shall be thoroughly cleansed of all grease, oil and other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in equal proportions of one pound to three gallons of water. Scrubbing and continuous agitation of the parts shall be employed where necessary to remove all deposits and to insure complete cleansing. After washing, all materials shall be rinsed thoroughly in clean, hot water. After rinsing, great care must be exercised in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease being introduced into the tubing. Where such contamination is known to have occurred, the materials affected must be rewashed and then rinsed.
- D. After erection of pipe and tubing, but prior to installation of the service outlet valves, each system shall be blown clear of moisture and foreign matter by means of dry nitrogen or oil free air.
- E. After installing service outlet valves, each system shall be subjected to a test pressure of 150 psig by means of water-pumped (oil free) nitrogen or air. This test pressure shall be maintained until each joint has been thoroughly examined for leaks by means of soapy water. A soap solution mixed in the following proportions should be used: one ounce of Castile or palm oil soap, eight ounces of water, and four ounces of glycerin. Dissolve the soap in the water, add the glycerin and mix thoroughly. Wipe joints clean after test. All leaks shall be properly repaired and the system retested.
- F. A final test shall be 24 hours standing pressure test with water pumped (oil free) air or dry nitrogen at 150 psig to check the completeness of prior joint pressure tests. If water pumped nitrogen is used, particular care must be exercised to assure that it is all flushed out with oxygen before placing the system in service.

- G. The piping systems shall be finally cleaned system cleaned using the high-pressure pulse-purge procedure described in NFPA 99. During this procedure, sufficient volume of dry nitrogen shall be provided to insure a minimum velocity of 2000 fpm in the largest section of pipe being cleaned. Note: It is not required that the entire system be tested at one time. The system can be divided into convenient sections. Upon the successful completion of the operation on a section, it shall be sealed and left with a holding charge of dry nitrogen.
- H. Threaded joints shall be limited to connection to equipment and outlets. Pipe threads shall conform to ANSI B1.20.1. Threaded joints shall be made using Teflon tape or other thread sealant recommended for oxygen service.

2.6 VALVES:

- A. Ball Valves: 3 Piece bronze ball valve with extended copper tube ends, 316 stainless steel ball and stem, 600 WOG, full port, in-line repairable, RPTFE seats, blow-out proof stem, manufactured by Milwaukee. No. BA3055-TE, Nibco or Apollo.
- B. Check Valves: 3 piece, Type K copper tube extension ends, dual gauge/purge ports, cleaned for oxygen service, brass construction, rated of 300 psi working pressure, 100% hydrostatically tested manufactured by Amico "Alert 1" series , US Valve or Gentec.

2.7 LABORATORY FITTINGS:

- A. Laboratory fittings will be furnished to the job site by the Laboratory Equipment Supplier, with necessary holes cut in the laboratory equipment. The Contractor shall receive, store, and install the fittings and make all necessary connections thereto.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Install compressor units' dryers and air receivers on a concrete housekeeping pad. Refer to Section 22 00 00.
- C. Install compressor units on vibration isolators. Level and bolt in place. Refer to Section 22 05 48.
- D. Make air cock and drain connection on horizontal casing.
- E. Install line size gate or ball valve (depending on size), and a check valve on compressor discharge.
- F. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.
- G. Place shut off valve on water inlet to aftercooler. Pipe drain to floor drain.
- H. Connect condensate drains to nearest floor drain.
- I. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
- J. Install valved drip connections at low points of piping system.
- K. Install take offs to outlets from top of main, with shut off valve after take off. Slope take-off piping to outlets.
- L. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.
- M. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- N. Identify and label piping system and components. Refer to Section 22 05 53.
- O. Provide flex connector on the air compressor intake and outlet piping, isolate filter housing from the intake manifold with a flex connector.

- P. The air compressor shall draw air from a source of clean air located where no contamination from engine exhausts, fuel storage vents, plumbing vents, building exhausts etc., occur. The air intake shall be a minimum distance of 25' from any door, window, exhaust or vent and a minimum distance of 20' above grade. The intake terminal shall be turned down and a stainless steel screen secured over the terminal point with adjustable stainless steel bands.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 22 00 00 (including Uniform General Conditions as referenced therein), and Section 22 13 16.
- B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.
- C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.
- D. Cap (seal) ends of piping when not connected to equipment.

3.3 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
 1. Complete installation and startup, checks according to manufacturers written instructions.
 2. Verify that all filters and piping are clean.
 3. Lubricate all devices requiring lubrication.
 4. Check all belts for proper tension.
 5. Check equipment vibration control supports and flex pipe connectors and verify all equipment is properly attaches to substrate.
 6. Check safety valve for correct settings
 7. Drain receiver tanks.
 8. Perform operational tests after electrical circuitry has been energized and start units to confirm proper performance.
 9. Test and adjust all controls and safeties.

END OF SECTION 22 15 13

SECTION 22 20 00 - PLUMBING PIPING, VALVES AND FITTINGS

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 2200 00 – Plumbing Basic Requirements
 - B. Section 22 05 29 – Plumbing Supports and Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES
- A. Pipe and Pipe Fittings
 - B. Valves
- 1.3 RELATED SECTIONS
- A. Section 02222 - Excavating
 - B. Section 31 23 23.13 - Backfilling
 - C. Section 31 23 16.13 - Trenching
 - D. Section 33 13 00 - Disinfection of Water Distribution System
 - E. Section 08 31 13 - Access Doors and Frames
 - F. Section 09 91 00- Painting
 - G. Section 22 05 48 –Plumbing Vibration Isolation
 - H. Section 23 07 19 - Plumbing Insulation
 - I. Section 22 13 16.A - Plumbing Specialties
 - J. Section 22 40 00 - Plumbing Fixtures
 - K. Section 22 11 23 - Plumbing Equipment
- 1.4 REFERENCES
- A. AGA - American Gas Association
 - B. ANSI B31.1 - Power Piping
 - C. ANSI B31.2 - Fuel Gas Piping
 - D. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems
 - E. ANSI B31.9 - Building Service Piping
 - F. ASME - Boiler and Pressure Vessel Code
 - G. ASME Sec. 9 - Welding and Brazing Qualifications
 - H. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
 - I. ASME B16.3 - Malleable Iron Threaded Fittings
 - J. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250
 - K. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings
 - L. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
 - M. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV
 - N. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes

- O. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- P. ASME B16.32 - Cast Copper Alloy Solder-Joint Fittings for Solvent Drainage Systems
- Q. ASTM A47 - Ferric Malleable Iron Castings
- R. ASTM A135 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- S. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- T. ASTM B32 - Solder Metal
- U. ASTM B42 - Seamless Copper Pipe
- V. ASTM B43 - Seamless Red Brass Pipe
- W. ASTM B75 - Seamless Copper Tube
- X. ASTM B88 - Seamless Copper Water Tube
- Y. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube
- Z. ASTM B302 - Threadless Copper Pipe (TP)
- AA. ASTM B306 - Copper Drainage Tube (DWV)
- BB. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- CC. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- DD. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings
- EE. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- FF. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- GG. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings
- HH. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- II. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping
- JJ. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter - Controlled Polyethylene Pipe
- KK. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- LL. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- MM. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems
- NN. ASTM D2855 - Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- OO. ASTM D3033 - Type PSP Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- PP. ASTM D3034 - Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- QQ. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System
- RR. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- SS. ASTM F493 - Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings
- TT. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Pipe
- UU. AWS A5.8 - Brazing Filler Metal. BA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
- VV. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids
- WW. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings

- XX. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
 - YY. AWWA C651 - Disinfecting Water Mains
 - ZZ. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hub less Cast Iron Sanitary Systems
 - AAA. CISPI 310 - Joints for Hub less Cast Iron Sanitary Systems
 - BBB. CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components
 - CCC. NCPWB - Procedure Specifications for Pipe Welding
 - DDD. NFPA 54 - National Fuel Gas Code
 - EEE. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases
 - FFF. TDH - Texas Department of Health, Water System Regulations
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 22 00 00.
 - B. Record actual locations of valves, etc. and prepare valve charts.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 22 00 00.
 - B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.8 QUALITY ASSURANCE
- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
 - C. Welder's Certification: In accordance with ASME Sec. 9. Submit welder's certifications prior to any shop or field fabrication. Welder's certifications shall be current within six months of submission.
 - D. Maintain one copy of each document on site.
- 1.9 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' documented experience.
 - B. Installer: Company specializing in performing the work of this section with minimum of three years' documented experience.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
 - B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
 - C. Provide temporary protective coating on cast iron and steel valves.
 - D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.12 EXTRA MATERIALS

- A. Furnish under provisions of Section 22 00 00.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 STEEL PIPING:

- A. Scope: This section applies to all piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: chilled water, hot water, steam, steam condensate, and fire protection systems.
- B. Pipe: Unless otherwise indicated, steel piping shall be Schedule 40, shall be Standard weight, Grade A or B, seamless black steel pipe conforming in all details to Standard ASTM Designation A135, A106, and A53, latest revisions.
- C. Fittings:
 - 1. All weld fittings shall be domestic made wrought carbon steel butt-welding fittings conforming to ASTM A234 and ASME/ANSI B16.9, latest edition, as made by Weld Bend, Tube Turn, Hackney, or Ladish Company. Attach to only pipe with a hole for the entire length. Each fitting shall be stamped as specified by ASME/ANSI B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random. Fittings which have been machined, remarked, printed, or otherwise produced domestically from non-domestic forgings or materials will not be acceptable. Each fitting is to be marked in accordance with MSS SP-25. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
 - 2. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Anvil, Crane Company or Walworth Company manufacture (300 lb. for unions).
- D. Fabrication:
 - 1. Welded piping and fittings in chiller and boiler plants shall be fabricated in accordance with ASME/ANSI the latest editions of Standards B31.1 and B31.3 for Steam and Condensate systems, from the Code for Pressure Piping. Standard B31.9 –Building Services Piping may be used within buildings. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
 - 2. Ensure complete penetration of deposited metal with base metal. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - 3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
 - 4. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
 - 5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
 - 6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.

7. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.
8. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be unpeened and hammered to remove all shavings and foreign material.

E. Weld Testing:

1. All welds are subject to inspection, visual, X-ray, or Ultrasound for compliance with specifications. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing. Initial visual and X-ray inspections will be provided by the owner. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1, B31.9, and B31.3 due to the discovery of poor, unacceptable, or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

2.2 CAST IRON PIPING:

A. Piping & Fittings:

1. Service weight cast iron soil pipe conforming to ASTM Specification A-74 and CISPI Standard 301, hub and spigot for pipe ten inch (10") and larger and hub less for eight inch (8") and smaller. Each piece of pipe and each fitting shall be coated at the factory with asphaltum or coal tar pitch and with the manufacturer's mark or name cast on it.
2. All joints in hub and spigot cast iron pipe shall be made water and gas tight with Tyseal neoprene gaskets. Lead and Oakum may be used only under special conditions, with prior written permission from the Resident Construction Manager. Joints in hub less cast iron soil pipe and fittings shall be made by the use of a neoprene sleeve and 24-gauge, Type 304 Stainless Steel shield made tight with a torque wrench and torqued to a minimum of 100 inch-pounds. Each clamp shall consist of a neoprene gasket with a stainless steel outer band which effectively captures the gasket material. Each clamp shall bear the FM and UPC stamp, shall be approved to Class I of Factory Mutual Standard #1680, and shall be Clamp-All, Anaco "Husky" SD 2000 or Mission "HW". All elbows and tees shall be braced against thrust loads which might result in joint separation due to static pressure or dynamic forces caused by sudden, heavy impulse loading (water hammer) conditions. Hub less piping systems shall not be used in a directly buried, underground application.

2.3 GALVANIZED STEEL PIPE

- A. Pipe: Schedule 40 and shall conform in every detail to ASTM Standard Specifications for black and hot dipped zinc-coated galvanized welded and seamless steel pipe ASTM Designation A-135, latest revision. This threaded pipe shall be supplied with thread protectors on each end. All steel water pipe shall be hot-dipped galvanized pipe zinc coated both inside and outside.
- B. Fittings: All fittings for six inch (6") and larger water lines shall be 125 lb., cast iron, flanged pattern fittings. These fittings shall be hot-dipped galvanized, after all machining operations have been completed. These fittings shall be of Crane Company, or approved equal, manufacture and their flanges shall be dimensioned, faced drilled and spot faced to conform to the Class 150 American Standard for Steel Pipe Flanges and Flanged Fittings.

2.4 COPPER PIPE

- A. Copper Pipe: Piping four inches (4") and smaller shall be fabricated of Type K, hard drawn, copper pipe made of deoxidized copper (99.9% pure). This Type K copper pipe shall conform in every detail to ASTM Standard Specifications for copper water tube, Serial Designation B-88-66, and it shall be provided in 20-foot straight lengths. Copper pipe 4" and smaller may only be joined using non-lead-bearing solder, such as 95-5 silver or antimony solder (95 percent tin, and 5 percent silver or antimony). Copper pipe 5" and larger may be joined using roll grooved fittings.
- B. Fittings: All fittings for four inch (4") and smaller water lines shall be Streamline Solder Fittings manufactured by Streamline Pipe and Fittings Division, Mueller Brass Company, Nibco Inc., or approved equal. These wrought copper fittings shall be rigid and strong with openings machined to accurate capillary fit for the pipe.
- C. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then ALL of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and reinstalled using ALL NEW MATERIALS.

2.5 PVC PIPING

- A. Only where allowed in another Division 22 specification. Type 1 Schedule 40 PVC pipe conforming to ASTM D-1784. For pressurized systems, pipe shall be marked with manufacturer's name or trademark, material designation code, nominal pipe size, pipe schedule size with pressure rating in PSI for water at 73 degrees F, the ASTM designation number D-1785 and the NSF seal for potable water. For gravity drainage systems pipe shall be marked with manufacturer's name or trademark, the ASTM designation code number D-2665, the nominal pipe size, the material abbreviation PVC, and the product abbreviation DWV spaced along the entire pipe length at not more than (2) foot intervals. For gravity drainage systems the fittings shall be DWV pattern with solvent cement joints conforming to ASTM D2665. For pressurized systems schedule 40 fittings shall conform to ASTM D-2466 with socket solvent cement joints.

2.6 VALVES:

- A. All valves in the domestic water system shall be Lead Free. All valves shall be located such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings. All valves must be of threaded or flanged type. **No solder connected or grooved fitting valves shall be used on this project.** All bronze and iron body gate and globe valves shall be the product of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc. The following manufacturers are acceptable: Apollo, Kitz, Nibco, Stockham, Milwaukee, Rockwell, DeZurik and Mueller.
- B. All valves used in plumbing systems shall be Class 150 SWP. Class 300 valves shall be constructed of all ASTM B-61 composition. All gate, globe and angle valves shall be union bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials. Alloys used in all bronze ball, gate, globe, check, or angle valves shall contain no more than 15% zinc. No yellow brass valves will be allowed.
- C. All iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron. Stem material shall meet ASTM B16 Alloy 360 or ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing.

- D. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16-34-1977. Stems shall meet ASTM designation A-186-F6 chromium stainless steel. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A-182-F6 chromium stainless steel on valves from 2" to 6". Sizes 8" and larger may be A-216-WCB with forged rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13% chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.
- E. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34 pressure-temperature rating.
- F. All valves shall be repackable, under pressure, with the valve in the full open position. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.
- G. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.
- H. Valves 12" and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 to accommodate a drain valve and equalizing by-pass valve assembly.
- I. Balancing and/or Shutoff Valves for Domestic Hot Water Systems: Two inches and smaller, three piece full port bronze body ball valve, stainless steel ball and stem. Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use in insulated lines. Cold water service valves shall be as above, except two piece construction. All valves 2 1/2" and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12" (150 psi for larger valves) when used for end of line service without requiring the installation of a blind flange on the downstream side. Liners shall be resilient material suitable for 225 °F temperature and bodies of ductile iron. Butterfly valves 8" and larger and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel or crank. Valves 2 1/2" through 6" shall have lever handles which can be set in interim positions between full open and full closed. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.
- J. Check Valves for Water Systems: Bronze body, 2" and smaller, bronze body regrinding disc and seat with screw-in cap. Iron body, 2 1/2" and larger, bronze disc and seat or non-slam wafer type with stainless pins and springs, and bronze plate. Forged steel lift check valves, 2" and smaller shall be bolted cap and body, screwed end connections and conform to ANSI B16.34 and pressure temperature rating.
- K. Gate valves 2 1/2" and larger shall have approved rating of 175 psi WWP or greater, iron body with resilient rubber encapsulated wedge, epoxy-coated interior and pre-grooved stem for supervisory switch.
- L. Standards of Quality for Valves:

Standard of Quality for Valves:

Size	Type	Service	Class	Milwaukee	Nibco	Stockham, or as
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*2" & smaller	Ball Valve for shut-off	Domestic Cold Water Systems	150	--	T-585-80-LF	Apollo77FLF-100
*2" & Smaller	Ball Valve for shut-off	Domestic Hot Water Systems & Recirculating Dom. Hot Water	150	--	T-595-Y-66-LF	Apollo 77-140

*Requires extended stems in insulated lines with adjustable memory stop.

2-1/2" & larger	Globe, Angle & Balancing	Plumbing	125	F-2981	F-718-B	G-514-T
2-1/2" & larger	Butterfly	Domestic Hot & Cold Water Systems Shutoff	150	NE-C,NF	LD2000	DeZurik 632, L, D, RS66,6

Valves 8" and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operator.

2" & smaller	Check Valve	All Water Systems	150	510	T-433-Y-LF	B-345
2-1/2" & larger	Check Valve	All Water Systems	150	1400 Series	W-920-W-LF	Stockham Duo-Check
2" & smaller	Isolation Ball Valve	Medical, & Lab Gases	150	BA-350-TE	CS-595-YX	--

1. Valves 8" and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operators.
2. *Requires extended stem in insulated lines.

2.7 UNIONS:

- A. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other special pieces of apparatus. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2 1/2" and larger shall be ground flange unions. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to EpcO.
- C. In all water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.8 FLANGES:

- A. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. All-thread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and rated at least ANSI Grade I.
- B. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.
- C. Flange Gaskets
 - 1. Gaskets shall be placed between the flanges of all flanged joints.
 - 2. Gaskets for all applications: Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
 - 3. Spares - Contractor shall provide ten spares for every flange size and rating.
- D. Flange Bolt Installation:
 - 1. Bolt Lubrication: Bolts shall be well lubricated with a heavy graphite and oil mixture.
 - 2. Torque Requirements - Bolts shall be stressed to 45,000 psi.

Nominal Bolt Dia. (Inch)	Torque (Ft-Lbs)
.25	6
.3125	12
.375	18
.4375	30
.5	45
.5625	68
.625	90
.75	150
.875	240
1.0	368
1.125	533
1.25	750
1.375	1020
1.5	1200
 - 3. Torque shall be checked with a calibrated breaking action torque wrench on the final torque round. Bolts shall be cold and hot torqued.
 - 4. Torque Pattern - Shall be a cross or star pattern with at least four passes. Limit each pass to 30% of full torque increases.
 - 5. Hot Torque - Re-torque the flange bolts with system at normal operating pressure and temperature for at least four hours.
 - 6. Inspection - Owner shall verify hot torquing of all medium and high pressure steam flange bolts.

PART 3 - EXECUTION

3.1 REFER TO OTHER SECTIONS FOR SERVICE SPECIFIC REQUIREMENTS.

3.2 EXAMINATION

- A. Verify excavations under provisions of Section 22 00 00.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

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

3.4 INSTALLATION

- A. Install unions downstream of valves and at equipment or apparatus connections. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- H. Establish elevations of buried piping outside the building to ensure a minimum of cover. Refer to Section 22 00 00.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.
- L. Excavate in accordance with Section 22 00 00 for work of this Section.
- M. Backfill in accordance with Section 22 00 00 for work of this Section.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

END OF SECTION 22 20 00

SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 22 00 00 – Plumbing
 - B. Section 22 05 29 – Plumbing Supports & Sleeves
 - C. Section 22 05 53 – Plumbing Identification
- 1.2 SECTION INCLUDES:
- A. Lavatories
 - B. Sinks
 - C. Water Closets
 - D. Faucets
 - E. Bathtubs
 - F. Thermostatic Mixing Valves
 - G. Vacuum Breakers
- 1.3 RELATED SECTIONS
- A. Section 06410 - Custom Casework: Preparation of Counters for Sinks
 - B. Section 06410 - Custom Casework: Lavatory Tops
 - C. Section 07 90 00 - Joint Sealers: Seal Fixtures to Walls and Floors
 - D. Section 22 05 29 - Plumbing Supports and Sleeves
 - E. Section 22 13 16 - Plumbing Piping
 - F. Section 22 13 16.A - Plumbing Specialties
 - G. Section 22 11 23 - Plumbing Equipment
- 1.4 ALLOWANCES
- A. Cash Allowance: Include under provisions of Section 22 00 00.
 - B. Allowance includes purchase and delivery of owner-selected fixtures. Installation is included in this section and is part of the Contract Sum/Price.
- 1.5 REFERENCES
- A. ANSI/ASME A112.6.1 - Supports for Off the Floor Plumbing Fixtures for Public Use.
 - B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
 - C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
 - D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.
 - E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - F. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
 - G. ANSI/ASME A112.19.5 - Trim for Water Closet Bowls, Tanks, and Urinals (Dimensional Standards).
 - H. IAPMO/ANSI Z124.1 - Plastic Bathtub Units.
 - I. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.

- J. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
 - K. ANSI/ARI 1010 - Drinking Fountains and Self Contained, Mechanically Refrigerated Drinking Water Coolers.
 - L. NSF/ANSI 61: Drinking Water System Components – Health Effects.
- 1.6 SUBMITTALS
- A. Submit under provisions of Section 22 00 00.
 - B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough in dimensions, utility sizes, trim, and finishes.
 - C. Manufacturer's Installation Instructions.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 22 00 00.
 - B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- 1.8 MOCKUP
- A. Provide mockup of typical bathroom group under provisions of Section 22 00 00.
 - B. Mockup may not remain as part of the Work.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Section 22 00 00.
 - B. Accept fixtures on site in factory packaging. Inspect for damage.
 - C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- 1.10 FIELD MEASUREMENTS
- A. Verify that field measurements are either as indicated on shop drawings or as instructed by the manufacturer, and designate in the submittal both that it has been verified, and which measurements are the basis for construction.
 - B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.
- 1.11 WARRANTY
- A. Provide five-year warranty under provisions of Section 22 00 00.
- 1.12 EXTRA MATERIALS
- A. Furnish under provisions of Section 22 00 00.
 - B. Provide two each of each type of faucet service kits, and flush valve service kits,.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide plumbing fixtures where indicated on the Drawings. These plumbing fixtures shall be standard products as manufactured by Kohler, Crane, American Standard. The fixtures shall be free from mars or chips and shall be new, first quality and shall be furnished with sufficient supports in order to adequately hang each and every unit. The space between fixtures and masonry walls shall be grouted with White General Electric Silicone flexible grout. The space between fixtures and sheetrock or wood panel walls shall not be grouted but the fixture shall fit flat against the wall surface with no more than 1/16" gap.
- B. All faucets, fittings, supply stops and similar devices shall be of one manufacturer unless otherwise specified. All water faucets and valve bodies shall be cast brass with a minimum copper content of 85%. They shall contain standardized interchangeable operating units constructed of a removable and replaceable unit containing all parts subject to wear. All water faucets shall contain an adjustable internal volume control unit. All exposed parts shall be chromium plated.
- C. All fixtures shall meet the requirements of ADA, ANSI A117.1, ANSI Z124.2 and the State of Texas Accessibility Standards (TAS).
- D. All faucets shall comply with NSF 61..

2.2 FITTINGS AND PIPES:

- A. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass wherever pipes pass through floors, walls or ceilings.
- B. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.
- C. Supplies for all lavatories, sinks, tank type water closets and drinking fountains shall be loose key angle stops with 1/2" I.P.S. female inlets and shall include wall flanges, and 1/2" O.D. flexible risers with bull-nose or flared end outlets. All components to be chrome plated. In all cases, all piping, tubing, fittings, and faucets shall be installed using a mechanical non-slip connection, such as bull-nose, flared, flanged, ferrule, or threaded fittings. Fittings requiring a friction fit using slip-on or gasketed connections are not acceptable.

2.3 LAVATORIES - GENERAL TOILET ROOMS - LAVATORY TYPE "L-1":

- A. American Standard "AQUALYN" No. 0475.020ADA compliant, white vitreous china, self-rimming, counter top, oval lavatory. Lavatory fixture shall measure 16-inches wide by 10-inches deep, shall have faucet holes on 8-inch centers and shall be equipped with integral front-overflow ports. Alternative acceptable manufacturers: Equal products by Kohler or Crane.
- B. Chicago Faucet 786-E2805-5ABCPADA compliant, 8-inch center spread, concealed fitting lavatory faucet with 5inch gooseneck spout, 4-inch wrist blade handles, 0.50 gpm vandal proof spray outlet. The force required to activate the faucet controls shall be no greater than 5 ftlb. Faucet shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Acceptable alternative manufacturers: Equal products by T&S Brass or Water Saver.
- C. McGuire No. 155WC, ADA compliant, chrome plated offset lavatory strainer, with heavy cast brass grid drain strainer, heavy cast base elbow and 1-1/4 inch 17-gauge tubular brass offset tailpiece. Acceptable alternative manufacturers: Equal products by Chicago, or Zurn.
- D. Chicago Faucet 1006-ABCP supplies, with loose key angle stops, lock shield caps, 1/2" I.P. female inlets 12" long, 1/2" O.D. flexible risers, wall flanges, and 1/2" O.D. flexible tube risers with bull-nose outlets. Acceptable alternative manufacturers: Equal products by McGuire or Zurn.

- E. McGuire 8902, (or) 1-1/4" inlet and 1-1/2" outlet adjustable cast brass P-traps with cleanout plug, brass threaded nipple from trap to tapped sanitary tee behind wall, chrome-plated cover tubing to wall and chrome plated wall escutcheon. Acceptable alternative manufacturers Equal products by: Zurn or Kohler.
- F. Insulate all exposed drain and supply piping with Plumberex Specialty Products "HANDY SHIELD," or equivalent model by Truebro, drain line and supply line safety covers.

2.4 SINKS - GENERAL USE - SINGLE COMP. TYPE "SK1":

- A. Elkay LR-2521, 25-inch x 21-1/4-inch x 7 7/8-inch deep self-rimming, single compartment, 18-gauge type 302 stainless steel sink with 3-faucet holes, one 3-1/2 inch drain hole and fully undercoated underside. Acceptable alternative manufacturer: Equal products by Just or Moen.
- B. Chicago Faucet 786-204-725AB ADA compliant, 8-inch center spread, concealed fitting faucet with 5-3/8 inch by 9-3/4 inch tall rigid/swing convertible gooseneck spout, 4-inch wrist blade handles, 1.5 gpm laminar flow control insert. The force required to activate the faucet controls shall be no greater than 5. Faucet shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Acceptable alternative manufacturers: Equal products by T&S Brass or Water Saver.
- C. Chicago Faucet 1006-ABCP supplies with loose key angle stops, lock shield caps, 1/2" I.P.S. female inlets, wall flanges and 1/2" O.D. flexible risers with bull-nose outlets. Acceptable alternative manufacturers: Equal products by McGuire or Zurn.
- D. McGuire No. 1151AWC, ADA compliant, chrome plated offset sink strainer with stainless steel strainer fitting, stainless steel conical strainer basket, neoprene stopper and 1-1/2 inch 17-gauge tubular brass offset tailpiece. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.
- E. McGuire No. 8912, 1-1/2" inlet and 1-1/2" outlet adjustable cast brass p-trap with cleanout plug, Type "L" hard drawn copper pipe with IPS brass threaded adapters on both ends to connect from trap to tapped sanitary tee behind wall and Chrome Plated escutcheon at wall. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.

2.5 SINKS - LABORATORY USE - SINGLE COMP. TYPE "SK-2":

- A. American Standard Denlyn, 14 1/4-inch x 10 3/4-inch x 6-inch deep wall mounted, vitreous china, 3-faucet holes, one 1-1/4 inch drain hole and rear overflow. Acceptable alternative manufacturers: Equal products by Just or Moen.
- B. Chicago Faucet 786-204726, ADA compliant, 8-inch center spread, concealed fitting faucet with 6 inch by 11-3/8 inch tall rigid/swing convertible gooseneck spout with vacuum breaker, serrated laboratory hose nozzle, 4-inch wrist blade handles, and 1.5 gpm laminar flow control insert. The force required to activate the faucet controls shall be no greater than 5. Faucet shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Acceptable alternative manufacturers: Equal products by T & S Brass or Water Saver.
- C. Chicago Faucet 828-ACP (For Deionized water), 6-inch by 12-1/2-inch tall polypropylene ultra pure water fitting with serrated nozzle, brass riser, flange and inlet shank with PFA tube, chrome plated spout and flange and polypropylene compression inlet. Acceptable alternative manufacturers: Equal products by T & S Brass or Water Saver.
- D. Chicago Faucet 1006-ABCP supplies with loose key angle stops, lock shield caps, 1/2" I.P.S. female inlets, wall flanges and 1/2" O.D. flexible risers with bull-nose outlets. Acceptable alternative manufacturers: Equal products by T&S Brass or Water Saver.
- E. McGuire No. 1151AWC, , ADA compliant, chrome plated offset sink strainer with stainless steel strainer fitting, stainless steel conical strainer basket, neoprene stopper and 1-1/2 inch 17-gauge tubular brass offset tailpiece. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.
- F. McGuire No. 8912 1-1/2" inlet and 1-1/2" outlet adjustable cast brass p-trap with cleanout plug, Type "L" hard drawn copper pipe with IPS brass threaded adapters on both ends to connect from trap to tapped sanitary tee behind wall and Chrome Plated escutcheon at wall. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.

2.6 SINKS - GENERAL USE - SINGLE COMP. TYPE "SK-3":

- A. Elkay LRAD-191955, ADA compliant, 19-inch x 19-inch x 5-1/2 inch deep self-rimming, single compartment, 18-gauge type 302 stainless steel sink with 3-faucet holes, one 3-1/2 inch drain hole and fully undercoated underside. Acceptable alternative manufacturers: Equal products by Just or Moen.
- B. Chicago Faucet 745-VO/ABCP knee action mixing valve with polished chrome wall bracket, loose key straight stops and on inlets. Provide polished chrome plated brass piping supplies and pipe escutcheons for each stop. Acceptable alternative manufacturers: Equal products by T&S Brass or Water Saver.
- C. Chicago Faucet 626-E29ABCP deck mounted faucet fitting with 2.2 gpm laminar flow outlet, 5-3/8 inch by 10-3/4 inch tall rigid/swing convertible gooseneck spout. Acceptable alternative manufacturers: Equal products by T&S Brass or Water Saver.
- D. McGuire No. 1151AWC, ADA compliant, chrome plated offset sink strainer with stainless steel strainer fitting, stainless steel conical strainer basket, neoprene stopper and 1-1/2 inch 17-gauge tubular brass tailpiece. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.
- E. McGuire 8912, 1-1/2" inlet and 1-1/2" outlet adjustable cast brass p-trap with cleanout plug, Type "L" hard drawn copper pipe with IPS brass threaded adapters on both ends to connect from trap to tapped sanitary tee behind wall and Chrome Plated escutcheon at wall. Acceptable alternative manufacturers: Equal products by Elkay, Zurn or Just.

2.7 WATER CLOSETS - GENERAL TOILET ROOMS

- A. American Standard "AFWALL" No. 2257.001 ADA compliant, 1.28-gpf (high efficiency toilet), white vitreous china, direct-fed siphon jet flushing action, elongated-front, wall-hung, flush valve water closet fixture with 1-1/2 inch top spud. Provide a wall hung bowl meeting the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Water closet fixture shall be designed to flush efficiently with a maximum 1.28-gallons of water total per flush. Toilet must be designed to carry up to 1,000 lb static force. Fixture shall be listed in the State of Texas Water Commission List of Approved Plumbing Fixtures. No wax rings will be permitted on fixtures. Sealing rings shall be resilient rubber. Acceptable alternative manufacturers: Equal products by Kohler or Crane.
- B. Zurn Aquafush ZA6000PL-HET or Sloan Royal 111-1.28 ADA compliant, diaphragm operated, quiet flush, exposed water closet flush valve made of brass with metal oscillating non-hold-open type handle, 1-inch IPS screw driver operated back check angle stop with protective cap, renewable main valve seat, adjustable threaded union tailpiece, vacuum breaker, 1-1/2 inch by 11-1/2 inch flush tube and connection with spud coupling for 1-1/2 inch top spud, spud securing nut, wall and spud flanges, 1-1/2 gallon flush regulator, all with polished chrome finish. Flush control shall be mounted on the wide side of the toilet area. The force required to activate the control shall be no greater than 5. Flush valve assembly shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Flush valve shall be designed to flush efficiently with a maximum 1.28-gallons of water total per flush. Flush valve shall be listed in the State of Texas Water Commission List of Approved Plumbing Fixtures.
- C. Bemis Commercial No. 1655SSCT white open front elongated seat with extra heavy duty, less cover, self-sustaining, check hinges, commercial fastening system molded solid plastic, 300 series stainless steel posts, American National Standard Z124.5 compliant. Acceptable alternative manufacturers: Equal products by American Standard, Kohler or Church.
- D. Cast iron adjustable water closet carrier with adjustable gasketed faceplate, universal floor mounted foot supports, ABS coupling with integral test cap, rear anchor foot, with flush valve piping support, load rated for 750 lbs, manufactured by Wade 300-series-XH, Acceptable alternative manufacturers: Equal products by Zurn, J.R. Smith or Josam.

2.8 DEMONSTRATION BATH TUB (SH-1):

- A. Free-standing Aquatic Model Number 260330 or approved equal. 60"x30"x72" nominal dimensions. High gloss acrylic finish with slip-resistant textured bottom. Unit shall not be connected to water or sanitary utilities.

2.9 VACUUM BREAKERS:

- A. All outlets with hose threads shall be provided with vacuum breakers. Where vacuum breakers have not been specified with fixture trim and on all hose faucets not associated with plumbing fixtures both inside and outside of buildings, contractor shall furnish and install 3/4" hose thread vacuum breakers attached to the hose outlet threads with tamper proof set screw. Vacuum breaker shall be as manufactured by Chicago Faucet (E-27 or E-22),. Acceptable alternative manufacturers: Equal products by Watts of Wilkins.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures, as indicated on the Drawings, reasonably implied therefrom, or as specified herein, unless specifically excluded.
- B. Plumbing fixtures shall be supplied, set and connected as listed herein and as shown on the Drawings. Fixtures shall be protected from damage during construction, and shall be thoroughly cleaned of all tape and adhesives prior to final acceptance.
- C. Coordinate special mounting heights of plumbing fixtures with architectural details of each toilet area.
- D. Install in accordance with manufacturer's instructions.
- E. Install each fixture with trap, easily removable for servicing and cleaning.
- F. Install components level and plumb.
- G. Install and secure all fixtures in place with specified wall carriers and bolts.
- H. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- I. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.
- J. Thoroughly caulk joint between fixtures and walls, countertops and/or floors with waterproof, mold resistant, non-toxic, non-shrinkable white tile caulk.
- K. All non-monolithic shower floors shall be provided with drain pan attached to floor drain flange in accordance with plumbing code. Refer to architectural drawings and specifications.
- L. Install water supply piping with stop on each supply to each fixture to be connected to water distribution piping.
- M. Install flush valves for accessible water closets and urinals with handle mounted on wide side of compartment, unless sensor operated.
- N. Install escutcheons at piping wall and ceiling penetrations in exposed locations, finished locations and with cabinets and millwork.

3.4 INTERFACE WITH OTHER PRODUCTS

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

3.5 ADJUSTING

- A. Adjust work under provisions of Section 22 00 00.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean work under provisions of 22 00 00.
- B. At completion clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 22 00 00.
- B. Do not permit use of fixtures during construction, until after Substantial Completion has been announced by Owner.

3.8 FIXTURE HEIGHTS

- A. Fixture size, design and mounting height shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS).
- B. Install fixtures to heights above finished floor as indicated.
- C. Water-Closet
 - 1. Standard 17 inches to top of bowl rim.
- D. Lavatory (wall hung)
 - 1. Standard 32 inches to top of basin rim.
- E. Water Closet Flush Valves
 - 1. Standard 10 inches min. above bowl rim.

END OF SECTION 22 40 00

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SECTION 22 62 19 - LABORATORY VACUUM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and applicable requirements of Division 1, General Requirements, and Section 22 05 00.3, Common Work Results for Plumbing, govern this Section.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide laboratory vacuum system as specified, scheduled, and indicated. Rough-in and make final connection of laboratory vacuum piping to overhead service carriers, counter turrets, wall turrets, fume hoods, biological safety cabinets, etc. Provide and install all pipe, fittings, valves, vacuum pump assemblies, etc. associated with the vacuum system for a totally complete operational system. Refer to Section 22 63 13.4, Laboratory Gas Systems, for laboratory gas components not included in this Section, but included in the scope of workTypes: The vacuum system required for the project include, but are not limited to, the following:
 - 1. Valves.
 - 2. Vacuum Pump Assembly.
 - 3. Pipe and Fittings.

1.3 RELATED SECTIONS

- A. Section 22 00 00, Common Work Results for Plumbing.
- B. Section 22 05 48, Vibration Isolation for Plumbing Piping and Equipment.
- C. Section 22 05 53, Identification for Plumbing Piping and Equipment.
- D. Section 22 05 13, Common Motor Requirements for HVAC Equipment.

1.4 GENERAL REQUIREMENTS

- A. Provide new equipment, approved, free from flaws and blemishes.
- B. Provide approved plumbing fittings for equipment connections.
- C. Equipment shall be product of one manufacturer. Fittings and valve connections of same type shall be product of one manufacturer.
- D. Protect equipment against use and damage during construction.

1.5 SUBMITTALS

- A. Shop drawing submittals shall include, but not be limited to, the following:
- B. Cut sheets on the following:
 - 1. Vacuum Pump Assembly.
 - 2. Pipe and Fittings.
 - 3. Valves.
 - 4. Floor plan layout showing all system components in the space available on the drawings.
 - 5. Additional information as required in Section 22 05 00, Common Work Results for Plumbing.
- C. O&M Manuals.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store pipe, fittings and valves in a clean, dry space and protect from the weather.

1.7 MAINTENANCE MATERIALS

- A. Vacuum Pump System supplier shall furnish a full complete set of replacement inlet air filter elements and a complete re-fill of lubricating oil for the gear boxes.

PART 2 - PRODUCTS

2.1 VACUUM PUMP ASSEMBLY

- A. Provide factory assembled packaged laboratory vacuum system, consisting of tank mounted simplex rotary vane air cooled type vacuum pump electric motor driven, a ASME receiver and a U.L. listed electrical control system mounted in a NEMA 1 enclosure. The components shall be assembled on a heavy-duty base to accommodate most existing doorways. The system shall include interconnecting piping (Type K copper or galvanized steel) and wiring to provide functional operating package, with applicable electrical and plumbing connections at the installation site. The packaged unit shall be factory tested prior to shipment and warranted for 24 months from date of shipment or 12 months from start-up, whichever comes first. Vacuum pumps shall be capable of 24" HGV on a continuous basis.
- B. Unit shall include paraflex or approved couplings and OSHA coupling guard, inlet check valves, vacuum gauge, vacuum inlet isolation valves, and inlet vacuum filters.
- C. The assembly shall be provided with an integral oil separation system that consists of no less than three stages of internally installed oil and smoke eliminators through which the exhaust gas stream must pass.
- D. Each vacuum pump shall be furnished with an automatic air purge system for lab applications.
- E. The assembly shall include a vacuum receiver tank, constructed to ASME standards, rated for full vacuum, three valve by-pass so receiver acts as both a knock out tank and inventory receiver, manual drain valve, sight glass vacuum gauge and the National Board label. The tank shall be either horizontal or vertical as scheduled on the drawings. Vacuum pums shall be mounted on structural steel stack type base. Vacuum pump shall be mounted on the receiver tank.
- F. Check valves, pump isolation valves, source isolation valve and flexible connectors shall be included.
- G. Each pump shall be direct driven by a TEFC, NEMA frame, continuous duty, 40°C, ball bearing, NEMA design B, Class F insulation motor for operation on 480 Volts-60 Cycle-3 Phase, with 1.15 service factor rating. Each drive motor shall incorporate a "soft-starting" feature which will prolong the life of the gearing in gearbox.
- H. The NEMA 1 Underwriters Laboratories Listed electrical control panel of the fuse-less design shall have a "Continuous On Demand" feature shall stop the operation of the motors during periods of low or no vacuum demand. The controls include individual self-protected protection, pressure transducers, and an electronic controller to automatically switch the operating sequence of the vacuum pumps. The cabinet door shall have an HMI (Human Machine Interface) system status display to include system vacuum, pump operation, accumulated time, maintenance interval, fault conditions and silence button, lighted Hand-Off-Automatic selector switches, and safety disconnect operating handles. Panel shall enable vacuum pumps to start-up in the soft start mode. Each vacuum pump shall have a minimum run time function inter-faced with the automatic air purge system
- I. All required local alarm functions shall be integrated into the packaged system. The circuitry shall be designed so the audible signal can be silenced and the visual indicator will remain until the fault has been cleared and the reset button actuated. Local alarm functions shall be provided high air discharge temperature. Dry contacts provided for general system fault alarm to the DDC system.
- J. Each vacuum pump shall be provided with a vacuum relief valve to protect the vacuum pumps.
- K. The system shall be shipped as one skidded piece. System shall be assembled on modular rigid structural steel base, pre-piped and pre-wired. Common single point system connections shall be vacuum inlet and 460 volt power supply.
- L. Vacuum Transducer Settings shall be 22-24 inches HGV.
- M. The system shall meet the latest edition of NFPA 99 standards, as applies to laboratories.
- N. Factory start-up supervision and in-service training will be provided by a qualified technical representative.
- O. Accessories included for job site installation are complete set of inlet and discharge flexible connectors, source isolation valve, vibration mounting pads and touch-up paint.

P. A vacuum exhaust line sloped back to vacuum pump system shall be installed to exhaust vapors and odors outside of building to point approved by Architect/Engineer. The exhaust line shall terminate adjacent to pumps in a drip leg of minimum 10" length with cock valve drain, for purpose of trapping condensates. Flexible hose connections and in-line exhaust mufflers shall be installed as shown on Drawings.

Q. Unit shall be manufactured by Ohio Medical, Beacon Medaes or Dekker.

2.2 LAB PIPE AND FITTINGS

A. Pipe shall be hard drawn Type "L" copper, conforming to ASTM B88, factory prepared for oxygen service, as specified herein. Fittings shall be seamless wrought copper, socket joint, ANSI B16.22. Joints shall be brazed, Nitrogen purge during brazing is not required. Unions shall be wrought copper with metal to metal seats. Brazing alloy shall be NFPA 99C compliant, conforming to BS EN 10044CP.

2.3 GAUGES

A. Bourbon tube type, with stainless steel spring, suspended movement, 316 stainless steel bourbon tube, with minimum 2-1/2 inch dial, shatterproof gas window with stainless steel case, 1/4 inch NPT brass socket connection, 1 percent full scale accuracy and shall be made in accordance with ASME 40.1 grade 1A, scale range in inches of mercury, manufactured by Trerice No. 700 series, or approved equal.

2.4 UNIONS

A. Provide Class 150, 300-pound water-oil-gas service wrought solder joint fitting, such as Nibco 633/733 union C x C, or approved equal, ANSI B16.22. Flange joints larger than 2 inch shall be brass. Provide dielectric isolating unions or connections between metallic piping of dissimilar metal.

2.5 VALVES

A. Ball Valves. Three piece, 600 psi WOG, cast brass body, RPTFE seats, full port, blowout proof stems, quarter turn handle with stainless steel ball and stem and extended female tube ends for brazing connection, in-line repairable, manufactured by Milwaukee BA-350-TE, or approved equal.

2.6 PIPE SUPPORTS

A. Refer to Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.

2.7 FLEXIBLE CONNECTORS

A. Refer to Section 22 05 48, Vibration Isolation for Plumbing Piping Equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Components: The supplier shall certify that the system as provided meets all the requirements of the plumbing code. Installation of pipe and fittings shall be per NFPA 99, as related to Laboratories.

B. Testing, Start-up and Certification: After checkout, testing and startup, the system supplier shall provide the Owner with a notarized letter certifying that the system is properly sized and installed and that the system is in proper working order and complies with all applicable requirements of NFPA, as related to Laboratories.

3.2 PRESSURE TESTING

A. Test piping and prove free of leaks at completion prior to beginning, cleaning, and purging.

B. Perform service leak tests as specified and per applicable requirements of state and local codes, ANSI/ASME B31.1 Code for Power Piping, on piping systems.

- C. Before acceptance of the work, pressure test completed systems in the presence of the Owner and authorities having jurisdiction.
- D. Test the piping systems per the applicable governing codes and the requirements specified. Pressure test the piping system as outlined in NFPA 99, with an initial pressure test set for 15 psi. Then a standing pressure test set at 24 inches Hg for 24 hours without leak. Provide equipment and materials and make test connections required to execute tests. Make tests before piping surfaces are concealed.
- E. Contractor shall furnish the compressed air or nitrogen to be used for test purposes.
- F. Other than standard piping, caps and valves, use only commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. The safe test pressure rating of plug used shall be not less than two times the actual test pressure being applied. Do not use expandable elastomer plugs for piping which could develop sufficient reactive force to cause damage to a structure, other piping or cause moving of thrust or anchor provisions in case of blow-out.
- G. Remove components from piping systems during testing whenever the component may sustain damage due to test pressure or test media. After completion of the test, reinstall the component and reapply test at the component pressure rating.
- H. Check system components such as valves for functional operational under system test pressure. If the test pressure exceeds the valve manufacturer's rating for seat test, the termination block valves shall remain open during the test and the system shall be blocked by other means.
- I. Prepare and maintain test records of piping systems tests. Records shall show Contractor personnel responsibilities, dates, test gauge identification numbers, ambient temperature, pressure ranges, rates of pressure drop and leakage rates. Notify Architect/Engineer and Owner prior to test for witnessing. Two record copies of acceptance tests shall be delivered to the Architect/Engineer after acceptance.
- J. Architect/Engineer shall approve test procedures before proceeding with the work.
- K. Upon successful completion of the system pressure testing, the system will be dried, sealed and left ready for connection of equipment by others.

3.3 FLUSHING, CLEANING, PURGING

- A. The piping system shall be thoroughly and completely purged with instrument grade compressed air or nitrogen upon completion of work. Erection, for piping, tubing and fittings not factory pre-cleaned, prior to shall be thoroughly cleansed of all grease, oil and other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in equal proportions of one pound to three gallons of water. Scrubbing and continuous agitation of the parts shall be employed where necessary to remove all deposits and ensure complete cleansing. After washing all materials, shall be rinsed thoroughly in clean hot water. After rinsing, great care must be exercised in the storage and handling of all materials and in the condition of tools used in cutting and reaming to prevent oil or grease being introduced into the tubing. Where such contamination is known to have occurred, the materials affected must be rewashed and rinsed.
- B. Where threaded connections are required at connection points to equipment or lab turrets and/or outlets, suitable adapters shall be provided with threaded connections. A thin past of litharge and glycerin shall be applied to the external threads only.
- C. After erection of pipe and tubing, but prior to installation of the service outlet valves, each system shall be blown clear of moisture and foreign matter by means of dry nitrogen.

3.4 PIPELINE IDENTIFICATION LABELS AND BANDS

- A. Refer to Specification Section 22 05 53.3, Identification for Plumbing Piping and Equipment.

3.5 INSTALLATION

- A. General: Installer shall examine conditions under which the system is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- B. Installation: The system shall be installed as shown on the drawings and in accordance with manufacturer's written instructions and detailed field installation drawings.
- C. Install capped drip leg 6 inches long at the end of the main piping runs with a valved drain piped to the nearest floor drain.
- D. Field insulate house chilled water supply and return piping extending to heat exchanger.

3.6 CONNECTIONS

- A. Brazed Connections.

3.7 BRAZED JOINTS

- A. All brazed joints shall be made with materials specified. The amount of brazing alloy used per connection shall be the minimum required to assure a leak tight joint.
- B. Make all cuts square. Remove all burrs and slivers prior to cleaning.
- C. Clean surfaces to be joined prior to brazing. Remove all oil, grease and heavy oxide. Clean pipe surfaces at least 1/2 inch beyond the full engaged length into the fitting. Care should be exercised to remove surface film but not metal. Clean socket of fitting with the same precautions observed.
- D. Brazing under nitrogen purge is not required. Follow the instructions of the manufacturer for joining procedures.
- E. Assemble joint making sure the tube is firmly against the end of the fitting socket.
- F. Strictly follow manufacturer's procedures.

3.8 DIELECTRIC CONNECTIONS

- A. Dielectric connections shall be used when joining piping of dissimilar metals such as copper to steel, cast iron, or malleable iron.
- B. Connections shall be made with dielectric screwed unions or with flanges having non-conducting gasket, washers and bolt inserts.
- C. Dielectric unions to meet requirements of ANSI B16.39. Dielectric flange fittings to meet requirements of ANSI B16.24 for bronze and ANSI B16.42 for iron.

3.9 ROUTE AND GRADES

- A. Route piping approximately as indicated in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Avoid routing piping at elevations capable of causing occupant hazards. Run exposed piping parallel to walls. Group piping whenever practical at common elevations.
- B. Piping shall be installed as nearly as possible parallel with or at right angles to the building walls. Install pipe straight and plumb. Springing or forcing piping into place will not be permitted unless specifically called for. Install piping in such a manner as to prevent strain on equipment connections.
- C. Provide clearance for installation and maintenance of valves, drains, unions and other piping specialties such as pressure gauges.
- D. Install plugged drip pockets at low points.
- E. Pipe take-offs from piping shall be off the top of the pipe, unless otherwise noted on drawings.
- F. At the base of the vacuum system pipe risers, install valve and threaded caps for draining of system.

3.10 START-UP SERVICES

- A. A manufacturer's factory trained representative shall be available on the job-site to check the installation and start-up of package. The manufacturer's representative shall be responsible for training the Owner's Representative on the operation and proper maintenance of the unit.
- B. After system has been in operation for 90 days, the Contractor shall check all seals and replace any which are defective.
- C. Contractor shall provide to Owner a written sequence of restarting vacuum pumping package upon event of vacuum pumping equipment being taken off-line.

3.11 IDENTIFICATION

- A. Refer to Section 22 05 00, Common Work Results for Plumbing, for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 62 19

SECTION 23 00 00 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED DOCUMENTS

- A. Basic and supplemental requirements common to HVAC.
- B. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and Division 01 of the specifications apply to the work specified in this section.
- C. All work covered by this section of these specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

1.3 GENERAL

- A. The Contractor shall execute all work herein after specified or indicated on accompanying drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the drawings
- B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation
- C. The Mechanical drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases, above suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Or where no ceilings exist. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted. All work shall be NFPA compliant and compliant with Insurance Underwriter requirements and guidelines.
- D. When the Mechanical drawings do not give exact details as to the elevation of pipe and ductwork, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping is generally intended to be installed true and square to the building construction, the drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas, unless there is no ceiling.

1.4 DEFINITIONS

- A. These definitions are included to clarify the direction and intention of these Specifications. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated Owner's representative.
 - 1. Concealed / Exposed: Concealed areas are those that cannot be seen by the building occupants. Exposed areas are all areas that are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.
 - 2. General Requirements: The provisions of requirements of other Division 01 sections apply to entire work of contract and, where so indicated, to other elements that are included in project. Basic contract definitions are included in the General Conditions.

3. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.
4. Directed, requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect/Engineer," "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
5. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.
6. As required: Where "as required" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
7. Furnish: The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."
8. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
9. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use.

1.5 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS

- A. General: Refer to Division 01 for construction phasing and time increments.
- B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. If city or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.
- C. All work performed on this project is under the authority of the State of Texas, therefore no local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to city controlled services. If inspections by city personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.
- D. Compliance: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

1.6 CONTRACT DRAWINGS

- A. All dimensional information related to new structures shall be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- B. The interrelation of the specifications, the drawings, and the schedules are as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following the contractually prescribed information flow requirements.
- C. Should the drawings or specifications conflict within themselves, or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished.

1.7 ALLOWANCES

- A. Cash Allowance: Refer to Division 01 of the Construction Documents for information and requirements.

1.8 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates: See "Special Conditions" and Bid Form.
- D. Any Alternate Proposals are summarized in Division 01 of the specifications. The Contractor is directed to refer to all sections of the specifications and drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.9 SUBMITTALS

- A. Refer to Division 1, UGC, and supplemental UGCs for specification requirements pertaining to timeliness of submission and review, quantity, and format. Each specification section describes the content of the submittals and any submittals which must be approved prior to submission of others.
- B. Proposed Products List: Include Products specified in the following sections:
 - 1. Section 23 05 13 - Motors
 - 2. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors
 - 3. Section 23 05 48 - Vibration Isolation
 - 4. Section 23 05 53 - Mechanical Identification
 - 5. Section 23 05 93 - Testing, Adjusting, and Balancing
 - 6. Section 23 05 93.A - Testing, Adjusting, and Balancing - Contractor Responsibilities
 - 7. Section 23 06 20- Hydronic Specialties
 - 8. Section 23 07 13 - Ductwork Insulation
 - 9. Section 23 07 19 - Piping Insulation
 - 10. Direct Digital Control Systems - See Drawings
 - 11. Section 23 20 10- Piping, Valves and Fittings
 - 12. Section 23 21 00 - Hydronic Piping
 - 13. Section 23 30 00 Underfloor Air Distribution
 - 14. Section 23 31 00 - Ductwork
 - 15. Section 23 33 00 - Ductwork Accessories
 - 16. Section 23 37 00 - Air Inlets and Outlets
 - 17. Section 23 37 16 - Fabric Ductwork
 - 18. Section 23 82 19 - Fan Coil Units
 - 19. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories clearly marked and/or highlighted, with non-applicable information or data clearly noted in a single submittal.
- C. Mark dimensions and values in units to match those specified.

- D. Submit fabrication drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment, (3) where called for elsewhere in these specifications; and (4) where specifically requested by the Architect/Engineer. Fabrication drawings shall be made at no additional charge to the Owner or the Architect/Engineer.

1.10 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to General Conditions for substitution of materials and equipment.
- B. General: Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment that will be submitted for incorporation into the project. The list shall be arranged in accordance with the organization of the specifications. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval. The initial list shall be submitted as herein specified. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these specifications have been met and samples shall be furnished when requested. All manufacturers' data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
- C. It is not the intent of the drawings and/or specifications to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- D. The specified products have been used in preparing the drawings and specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the Architect/Engineer is final.
- E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- F. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- G. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.
- H. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

- I. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the specifications.
- J. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- K. Materials and Equipment Lists: Eight (8) copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer. The lists shall be accompanied by eight (8) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the shop drawings.
- L. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.11 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site but shall be replaced with new materials and/or equipment.
- B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.12 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.13 REGULATORY REQUIREMENTS

- A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of Texas. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications. All referenced codes and standards shall be those current at the date of issue of the design documents.
- B. National Fire Protection Association Standards (NFPA)
 - 1. NFPA No. 45, Fire Protection for Laboratories Using Chemicals
 - 2. NFPA No. 51, Welding & Cutting, Oxygen-Fuel Gas Systems
 - 3. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
 - 4. NFPA No. 70, National Electrical Code
 - 5. NFPA No. 72D, Proprietary Signaling Systems
 - 6. NFPA No. 90A, Air Conditioning Systems
 - 7. NFPA No. 91, Blower & Exhaust Systems
 - 8. NFPA No. 99, Health Care Facilities
 - 9. NFPA No. 101, Life Safety Code
 - 10. NFPA No. 211, Chimneys, Fireplaces, Vent Systems
 - 11. NFPA No. 241, Standard for Safeguarding Construction, Alteration and Demolition Operations
 - 12. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials

13. NFPA No. 258, Standard Research Test Method for Determining Smoke Generation of Solid Materials
 - C. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards
 - D. American National Standards Institute (ANSI)
 1. A40.8, National Plumbing Code
 2. B31.1, Power Piping
 3. B9.1, Safety Code for Mechanical Refrigeration
 - E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these specifications.
 - F. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes
 - G. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards
 - H. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.
 - I. International Mechanical and international plumbing Codes
 - J. Texas Occupational Safety Act: All applicable safety standards.
 - K. City of Houston, Fire Department as may be applicable to construction on this site.
 - L. Occupational Safety and Health Act (OSHA).
 - M. ADA and ANSI Standards: All work shall be in accord with all regulations and requirements of the Standards and Specifications for Handicapped and Disabled for the Construction of Public Buildings and Facilities in the State of Texas Usable by Physically Handicapped and Disabled persons, ANSI Standards and the requirements of the American Disabilities Act.
 - N. Refer to specification sections hereinafter bound for additional Codes and Standards.
 - O. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. In all cases where Underwriters Laboratories, Inc. has established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.
 - P. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 01 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations
- 1.14 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS
- A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
 - B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

- C. Conformance with Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
 - D. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
 - E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8" on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item. Where steel is specified to be hot dip galvanized, mill galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
 - F. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.
 - G. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.
- 1.15 WALL, FLOOR AND CEILING PLATES
- A. SEE SECTION 23 05 29 – Sleeves, Flashings, Supports and Anchors.
- 1.16 SLEEVES, INSERTS, AND FASTENINGS
- A. See Section 23 05 29 - Sleeves, Flashings, Supports and Anchors.
- 1.17 PROJECT/SITE CONDITIONS
- A. Install Work in locations shown on drawings, unless prevented by Project conditions.
 - B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other sections. Obtain permission of Architect/Engineer before proceeding.
- 1.18 MANUFACTURER'S RECOMMENDATIONS
- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, testing, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturer's directions, and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.19 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of Fire Protection equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.20 LARGE APPARATUS

- A. Any large piece of apparatus that is to be installed in any space in the building, and that is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.21 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

1.22 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.23 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT

- A. The Contractor shall note that the electrical design and drawings are based on the equipment scheduled and indicated on the drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- B. The electrical trades shall provide all interconnecting wiring for the installation of all power. The electrical trades shall provide all disconnect switches as required for proper operation, as indicated on the drawings or required by applicable code. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division 26.

- C. Provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review within thirty (30) days after the submittals for equipment have been reviewed. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control drawings, not a series of manufacturer's individual diagrams. After these diagrams have been reviewed by the Architect/Engineer, copies shall be transmitted to the electrical trades by the Contractor.

1.24 SUPERVISION

- A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)
- B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the drawings, the matter shall be referred to the A/E for ruling.

1.25 SITE OBSERVATION

- A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.26 INSTALLATION METHODS

- A. Where to Conceal: All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings below concrete beams or other deep projections, pipe shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration.
- E. All pipe shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All pipes run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
 - 1. All piping not directly buried in the ground shall be considered as "interior piping."
 - 2. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above ceiling area about to be "sealed" off. The Contractor shall give as much advance notice as possible no less than 5 working days or as agreed by the Project Manager.

3. All above ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All mechanical and electrical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets and lighting fixtures shall be complete and installed in accordance with contract requirements, including power to fans, and other powered items. Adequate lighting shall be provided to permit thorough inspection of all above ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Architect/Engineer, Physical Plant, Resident Construction Manager's Construction Inspector(s), the Resident Construction Manager, and Office of Facilities Planning and Construction (OFPC). Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
4. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

1.27 RECORDS FOR OWNER

- A. The Contractor shall maintain a set of "blue-line" prints in the Field Office for the sole purpose of recording "installed" conditions. Daily note all changes made in these drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.
- B. At contract completion, the Contractor shall provide an electronic file of the revised drawings. The contractor shall transfer the information from the "blue-line" prints maintained as described above, and turn over this neatly marked set of reproducible drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these specifications, and to the Uniform General Conditions, for additional information. These drawings shall include as a minimum:
 1. Addendum written drawing changes.
 2. Addendum supplementary drawings.
 3. Accurate, dimensioned locations of all underground utilities, services and systems.
 4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.
 5. Change Order written drawing changes.
 6. Change Order supplementary drawings.
- C. Electronic Media
 1. The contractor shall submit three compact discs containing all the drawings in AUTOCAD 12 or 14 format.
- D. "As installed" plans shall bear a stamp, "stick-on decal" or lettered title block generally located in lower right hand corner of drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.
- E. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in duplicate, prepared in a neat brochure or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.
 1. All warranties and guarantees and manufacturers' directions on equipment and material covered by the Contract.
 2. Two sets of operating instructions for heating and cooling and other mechanical and electrical systems. Operating instructions shall also include recommended preventative maintenance and seasonal changeover procedures.
 3. Valve tag charts and diagrams specified herein.
 4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
 5. Copies of approved shop drawings.

6. Any and all other data and/or drawings required as submittals during construction.
 7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.
- F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.

1.28 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes shall be core drilled to exact size.
- C. Restoration: All openings shall be restored to "as new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.
- E. Plaster: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. Special Note: No cutting, boring, or excavating that will weaken the structure shall be undertaken.

1.29 OPERATION PRIOR TO COMPLETION

- A. When any piece of Fire Protection equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Project Manager's written permission to do so. The warranty period shall, however, not commence until the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust and complete all deficiency list items prior to being started, commissioned and before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

1.30 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workers, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall them upon completion of work in the areas affected.

- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, and piping.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, coordination meetings shall be included in the contract amount.

1.31 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workers skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.32 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Check inspections shall include heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.

1.33 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

1.34 CLEANING AND PAINTING

- A. All equipment and piping, etc., furnished and installed in exposed areas under Division 23 of these specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 23 work.
- B. All purchased equipment shall be delivered to the job with a suitable factory protective finish with the colors hereinafter specified. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.
- C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metalwork shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.
- D. Color of finish painting shall be painted in accordance with The University of Texas Standard Color Schedule for machinery spaces using Pratt and Lambert, Inc.'s "Effector" enamel, or approved equal. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

ITEM	COLOR	"P and L" PAINT NUMBER
Piping (Insulated and Uninsulated)	Light Gray	B798M (London Fog)
Hanger Rods	Same as "Piping" above	
Ductwork, AHU, Fans and Insulation	Buff	Y354M (Tawny Gold)
Valve Hand Wheels	Blue	B726M (Siam Blue)
Pump Couplings and	Safety Yellow	Y361M (Daisy Yellow)

- E. Jacketing on insulation shall not be painted.
- F. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible due to the painting operation.
- G. Scope of painting for Division 23--work in areas other than those defined as "exposed" is as follows:
 1. All uncovered steel pipe, supports, exposed pipe and hanger rod threads, and hangers in underfloor spaces shall be cleaned and painted with two coats of Tropical Paint Co. No. 77-black asphaltic emulsion. Galvanized steel and copper lines in these spaces shall not be painted.
 2. All canvas finishes including those underfloor and in concealed spaces shall be painted with one sizing coat if not already sized, containing mildew resistant additive and Arabol adhesive prior to any other specified finish paint.
 3. All fire protection piping shall be painted whether concealed or exposed, in all areas of the project without exception. Fire protection piping shall be painted safety red. These "safety" colors shall be as defined by OSHA.
 4. If insulated, the piping shall be primed, only, prior to insulation, and the insulation jacketing shall be painted as specified for piping. The requirements of this paragraph are "primary" and have priority over any conflicting specification or instruction, should a conflict in the Construction Documents exist.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.
- C. Responsibility for furnishing proper equipment and/or material and ensuring that equipment and/or material is installed as intended by the manufacturer, rests entirely upon the Contractor. Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.
- D. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.
- E. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be by a non-domestic manufacturer provided they fully comply with Contract Documents.
- F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.2 NAMEPLATES

- A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
- B. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters.
- C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.
- D. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.
 - 1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.3 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.
- B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.
- C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.
- D. Plates will not be required for piping where pipe sleeves extend ¾-inch or more above finished floor.

2.4 ACCESS DOORS

- A. A.General: This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.
- B. B.Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.
- B. The size of equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine that the equipment proposed will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- D. Space Requirements:
 - 1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
 - 2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.
- E. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

3.2 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations, as shown on the drawings and stated in the specifications.
- C. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible.
- D. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
- E. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days prior to the inspection.

- F. Precedence of Materials:
1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.
 2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":
 - a. Building lines
 - b. Structural members
 - c. Structural support frames supporting ceiling equipment
 - d. Electric tracked vehicle system
 - e. Pneumatic trash and linen system
 - f. Pneumatic tube system
 - g. Soil and drain piping
 - h. Vent piping
 - i. Supply, return and outside air ductwork
 - j. Exhaust ductwork
 - k. HVAC water and steam piping
 - l. Condensate piping
 - m. Fire protection piping
 - n. Natural gas piping
 - o. Medical/Laboratory gases
 - p. Domestic water (cold and hot, softened, treated)
 - q. Refrigerant piping
 - r. Electrical conduit
 3. Coordinate fire protection system with other trade systems as required to maintain system right-of-ways.

3.3 TESTING

- A. When any piece of equipment is operable and it is to the advantage of the Contractor to operate the equipment, Contractor may do so, provided that Contractor properly supervises the operation, and has the Project Manager's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of Substantial Completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean and properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.
- C. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.
- D. Notify the Project Manager and the Architect/Engineer in writing at least five (5) calendar days or as agreed by the Project Manager prior to each test and prior to other Specification requirements requiring Owner and Architect/Engineer to observe and/or approve tests.
- E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.
- F. Maintain Log of Tests as hereinafter specified.
- G. See specifications hereinafter for additional tests and requirements.
- H. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.4 PIPING PRESSURE TESTS

A. The following lines shall be tested at the stated pressure for the length of time noted:

<u>Testing Service</u>	<u>Testing Medium</u>	<u>Pressure (PSIG)</u>	<u>Time in Hours</u>
Chilled Water	Water	150	241

B. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."

3.5 TRAINING

A. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."

END OF SECTION 23 00 00

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SECTION 23 05 13 – MOTORS

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 SECTION INCLUDES
- A. Single phase electric motors
 - B. Three phase electric motors
 - C. The Contractor shall provide all motors required for equipment supplied under this Division of the work
- 1.3 RELATED WORK
- A. Section 23 82 19 – Fan Coil Units
- 1.4 REFERENCES
- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
 - C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators
 - D. ANSI/NEMA MG 1 - Motors and Generators
 - E. ANSI/NFPA 70 - National Electrical Code
- 1.5 SUBMITTALS
- A. Submit product data under provisions of Section 23 00 00
 - B. Submit test results verifying nominal efficiency and power factor for motors 1 horsepower and larger.
 - C. Submit manufacturer's installation instructions under provisions of Section 23 00 00
- 1.6 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 23 00 00
 - B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.
- 1.7 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacture of electric motors for commercial use, and their accessories, with minimum three-years documented product development, testing, and manufacturing experience.
- 1.8 REGULATORY REQUIREMENTS
- A. Conform to ANSI/NFPA 70.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 23 00 00.
 - B. Store and protect products under provisions of Section 23 00 00.

- C. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.10 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Section 23 00 00.
- B. Warranty: Include coverage for motors 1 horsepower and larger.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Open Design Motors: Design for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.
- B. Totally Enclosed Motors: Design for a service factor of 1.00 and an 80 degrees C maximum temperature rise in the same conditions.
- C. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.
- E. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
- F. Motors shall be built in accordance with the latest ANSI, IEEE, and NEMA Standards, and shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled, and of approved manufacture as described herein or of the same manufacture as the equipment which they serve. All motors provided by the Contractor shall be of the same manufacture unless they are an integral part of the piece of equipment to which they are attached. Nameplate rating of motors shall match the characteristics scheduled.
- G. All motors shall be designed for NEMA Design B starting torque unless the driven machine requires high starting torque and shall be selected for quiet operation, free from magnetic hum.
- H. In addition, all motors shall be provided with adequately sized electrical connection box with threaded hub for attachment of flexible conduit, unless bus duct connection is indicated. Where motors are connected to driven equipment by the use of a V-belt drive, they shall be furnished with adjustable rails.
- I. Dynamic Balance shall be no greater than the vibration limits of the driven equipment.
- J. All motors shall be provided with all copper windings, terminal wiring, and copper or bronze lugs. AL/CU rated connectors are not allowed.

2.2 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

- F. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors with drip-proof enclosures except as hereinafter specified. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.
- E. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Enclosures shall be of the open drip-proof type with a service factor of 1.15 and Class B insulation rated at 90 degrees C temperature rise measured above 40 degrees C room ambient condition at full load, unless otherwise noted.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.
- H. Single phase motors, in general, shall be less than 3/4 horsepower and shall be permanent split phase, capacitor start, induction run, 120 volt, 60 hertz motors. These motors shall have built-in thermal overload protection with automatic reset, and shall be rated for temperature rise as hereinbefore specified for 3-phase motors.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Motors drawing less than 250 Watts and intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.
- B. Motors shall be open drip-proof type, unless specified otherwise.
- C. Single phase motors for [shaft mounted fans] [oil burners] [centrifugal pumps] shall be split phase type.
- D. Single phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.
- E. Single phase motors for [fans] [pumps] [blowers] [air compressors] shall be capacitor start type.
- F. Single phase motors for [fans] [blowers] [pumps] shall be capacitor start, capacitor run type.

END OF SECTION 23 05 13

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SECTION 23 05 29 – SLEEVES, FLASHINGS, SUPPORTS, AND ANCHORS

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 53 – Mechanical Identification

1.2 SECTION INCLUDES

- A. Pipe and equipment hangers and supports
- B. Equipment bases and supports
- C. Sleeves and seals
- D. Flashing and sealing equipment and pipe stacks
- E.

1.3 RELATED SECTIONS

- A. Section 07 84 00 Firestopping: Joint seals for piping and duct penetration of fire rated assemblies
- B. Section 09 91 00 Painting
- C. Section 23 05 48 Vibration Isolation
- D. Section 23 07 19 Piping Insulation
- E. Section 23 07 16 Ductwork Insulation
- F. Section 23 21 00 Hydronic Piping

1.4 REFERENCES

- A. ASME B31.1 Power Piping
- B. ASME B31.5 Refrigeration Piping
- C. ASME B31.9 Building Services Piping
- D. ASTM F708 Design and Installation of Rigid Pipe Hangers
- E. MSS SP58 Pipe Hangers and Supports Materials, Design and Manufacturer
- F. MSS SP69 Pipe Hangers and Supports Selection and Application
- G. MSS SP89 Pipe Hangers and Supports Fabrication and Installation Practices

1.5 SUBMITTALS

- A. Submit under provisions of Section 23 00 00.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of hydronic, steam and steam condensate piping.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Anvil
 - 2. Kindorf
 - 3. B-Line
 - 4. Power Strut
- B. Supports, hangers, anchors and guides shall be provided for all horizontal and vertical piping. Shop Drawings shall be provided, indicating locations and details of anchors, guides, expansion loops and joints, hangers, etc. The hanger design shall conform to the ASME Code for Pressure Piping.
- C. All auxiliary steel required for supports, anchors, guides, etc. shall be provided by the Mechanical Trades unless specifically indicated to be provided by others.
- D. The supports, hangers, anchors, and guides for the chilled water supply and return piping, steam piping, condensate return piping, etc. of the Campus Loop System routed through utility tunnels and below buildings shall be provided as indicated on the Drawings.
- E. Contractor shall review all Drawings, including Structural Drawings, for details regarding pipe supports, anchors, hangers, and guides.
- F. All Supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- G. All rod sizes indicated in this Specification are minimum sizes only. This trade shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.
- H. Anchor points as indicated on Drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.
- I. Guide points shall be located and constructed wherever required or indicated on Drawings and at each side of an expansion joint or loop, to permit free axial movement only.
- J. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- K. Hangers supporting and contacting brass or copper lines 3" in size and smaller shall be Anvil Fig. CT-65, adjustable, copper plated, clevis hanger. Hangers supporting and contacting brass or copper lines 4" and larger shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. For insulated copper or brass domestic water lines, hangers for all sizes of pipe shall be Anvil Fig. 300, adjustable clevis, with a nut above and below the hanger, and approved neoprene isolating material between pipe (or tubing) and hanger on the support rod. Isolate all copper or brass lines from all ferrous materials with approved dielectric materials. Hangers supporting and contacting plastic or glass piping shall be of equal design, but shall be padded with neoprene material or equal. The padding material and the configuration of its installation shall be submitted for approval.
- L. Hangers supporting insulated lines where the outside diameter of the insulation is the equivalent of 8" diameter pipe or smaller in size and supporting all ferrous lines 6" and smaller in size shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.
- M. Hangers supporting and contacting ferrous lines larger than 6" in size and outside of insulation on lines with the outside diameter equivalent to 10" diameter pipe shall be Anvil Fig. 260, adjustable clevis, with a nut above and below the hanger on the support rod.
- N. Other special type of hangers may be employed where so specified or indicated on the Drawings, or where required by the particular conditions. In any case, all hangers must be acceptable to the owner.

- O. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines where specified. Hangers for dual or low temperature insulation pipes shall bear on the outside of the insulation, which shall be protected by support shields as specified in Section 23 07 19 PIPING INSULATION. Protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. Hangers for high temperature insulated pipes and all insulated hot and cold domestic water pipes shall be encased in the insulation unless supported by trapezes in which case shield and rigid insulation shall be provided as specified above for low temperature insulated pipes.
- P. Supports for vertical piping in concealed areas shall be double bolt riser clamps, Anvil Fig. 261, or other approved equal, with each end having equal bearing on the building structure, and located at each floor. Two hole rigid pipe clamps at 4 ft. o.c. or Kindorf channels and Anvil Fig. 261 riser clamps may be used to support pipe directly from vertical surfaces or members where lines are not subject to expansion and contraction. When piping is subject to expansion and contraction, provide spring isolators (see Section 23 05 48 - Vibration Isolation). Where brass or copper lines are supported on trapeze hangers or Kindorf channels the pipes shall be isolated from these supports with plastic tape with insulating qualities, or strut clamps as manufactured by Specialty Products Company, Stanton, California.
- Q. Supports for vertical piping in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the building structure above the top of the riser, and the underside of the penetrated structure. The contractor shall use a drilled anchor as specified above, and use an Anvil No. 595 Socket Clamp with Anvil No. 594 Socket Clamp Washers, as a riser clamp. The top riser hanger shall consist of two (2) hanger rods (sized as specified) anchored to the underside of the building structure, supporting the pipe by means of the material specified. Risers penetrating floors shall be supported from the underside of the penetrated floor as specified for the top of the riser.
- R. Pipe Supports in Chases and Partitions: Horizontal and vertical piping in chases and partitions shall be supported by hangers or other suitable support. Pipes serving plumbing fixtures and equipment shall be securely supported near the point where pipes penetrate the finish wall. Supports shall be steel plate, angles, or special channels such as Unistrut mounted in vertical or horizontal position. Pipe clamps such as Unistrut P2426, P2008, P1109 or other approved clamps shall be attached to supports. Supports shall be attached to wall or floor construction with clip angles, brackets, or other approved method. Supports may be attached to cast iron pipe with pipe clamp, or other approved method. All copper or brass lines shall be isolated from ferrous metals with dielectric materials to prevent electrolytic action.
- S. Perforated strap iron or wire will not, under any circumstances, be acceptable as hanger material.
- T. Vibration Isolation: Resilient hangers shall be provided on all piping connected to rotating equipment (pumps, etc.). Piping or ductwork that may vibrate and create an audible noise shall also be isolated. Spring hangers or supports shall be provided where indicated on the Drawings and/or specified under Section 23 05 48.
- U. Attachment:
1. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
 2. Inserts shall be of a type which will not interfere with reinforcing as shown on the structural Drawings and which will not displace excessive amounts of structural concrete.
 3. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
 4. Hangers shall be attached to the structure as follows:

- a. Poured In Place Concrete: Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I beam, etc. spanning across two adjacent joists. The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - b. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - c. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 - d. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 - e. Pre Cast Tee Structural Concrete: Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod. Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees."
 - f. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.
 - g. Note: Power actuated fasteners (shooting) will not be acceptable under any circumstances.
 - h. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- V. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Anvil, Kindorf, Uni-Strut, Power Strut, or approved equal, channel suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- W. Finishes: All hangers on piping including clevis hangers, rods, inserts, clamps, stanchions, and brackets, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate. Universal concrete inserts shall be cadmium plated.
- X. Ductwork: All ductwork shall be supported in accordance with the SMACNA recommendation for the service involved; however, all horizontal ductwork shall be supported at intervals not to exceed the scheduled values indicated elsewhere in this section. Horizontal ducts shall be supported using galvanized steel bands extending up both sides and onto the construction above, where they shall turn over and be secured with bolts and nuts fitted in inserts set in the concrete bolted to angles secured to the construction above, or secured in another approved manner. For attaching methods for precast double tee structural concrete, refer to details on the Drawings and as specified herein.

- Y. Terminal units shall be supported by four 16 gauge, 1" wide sheet metal straps which shall be folded under the bottom of the casing a minimum of 1". Attach each strap to bottom of terminal unit with two sheet metal screws not larger than 3/4" in length and not more than 1/4" in diameter. The straps shall be attached to the structure by a 1/4" diameter threaded bolt into a concrete insert or into a drilled hole with a threaded concrete expansion anchor. Where interferences occur, overhead of the box, not allowing direct vertical support by straps, provide trapezes of Kindorf, Unistrut, or B-Line channel suspended by 1/4" diameter galvanized threaded rods providing such channels do not block access panels of boxes. Threaded rods shall be supported from structure by concrete insert or by drilled-hole threaded concrete expansion anchor.
- Z. Miscellaneous: Provide any other special foundations, hangers and supports indicated on the Drawings, specified elsewhere herein; or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Architect/Engineer.

2.2 ACCESSORIES

- A. Hanger Rods: Galvanized mild steel threaded both ends, galvanized threaded one end, or galvanized continuous threaded.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.

2.3 WALL, FLOOR AND CEILING PLATES:

- A. Except as otherwise noted, provide C.P. (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4" above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have closure plates (NOT chrome plated) made to fit accurately at all floor, wall and ceiling penetrations. Floor penetrations in exposed (except in stair wells) areas shall be finished using 'bell' fitting to fit pipe or insulation and sleeve and shall be painted to match the pipe. Penetrations in stairwells shall have flat floor plate painted to match pipe.

2.4 SLEEVES

- A. General: All openings through all floors, walls, and roofs, etc., regardless of material for the passage of piping, ductwork, conduit, cable trays, etc., shall be sleeved. All penetrations must pass through sleeves. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing vertical solid concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.
 1. Sleeve material for floors and exterior walls shall be Schedule 40 galvanized steel with welded water stop rings.
 2. Sleeves through interior walls to be galvanized sheetmetal with gauge as required by wall fire rating, 20 gauge minimum.
- B. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeve shall be 1/4", except that the minimum clearance shall accommodate a Thunderline Link seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc., plus any specified insulation. Void between sleeve and pipe in interior penetrations shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.

- C. Floor sleeves shall extend above the finished floor as detailed on the drawings, except that floor sleeves in stairwells shall be flush with the finished floor. Sleeves in walls shall be trimmed flush with wall surface. Refer to the details on the project drawings. Where the details differ from these specifications, the drawings take precedence.
- D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.
- E. Vermin proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be vermin proofed in a manner acceptable to the Architect/Engineer.
- F. Waterproofing: The annular space between a pipe and its sleeve in interior floors shall be filled with polyurethane foam rods 50 percent greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of floor.
- G. Air Plenums: The space around piping, ductwork, etc., passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.
- H. Fireproofing: Seal all cable trays, pipe, conduit, duct, etc., penetrations through roof, fire rated walls and floors with a foam or sealant as described below that will form a watertight, vermin tight barrier that is capable of containing smoke and fire up to 2000 ° F for two hours. Sealing of cable trays and conduits that extend through rated walls from ends of cable tray shall be done after conductors have been installed. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1 1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.

- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed, but shall be corrosion protected with galvanized plating. Repair any damaged galvanized plating with a coating of 'Galvalum'.
- L. Hanger Rods: (NOTE: All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the contractor shall take appropriate measures to protect the pipe or other materials from damage.)

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors (except in stairwells) two inches above finished floor level. Sleeves through floors shall have welded waterstop rings. Sleeves shall be sealed watertight to floors and pipe.
- D. Where piping, ductwork or conduit penetrates floor, ceiling, or wall, close space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers, as appropriate, at both sides of penetration.
- E. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.6 PIPE SUPPORT SCHEDULES

STEEL PIPE SIZE <u>Inches</u>	MAX HANGER SPACING <u>Feet</u>	HANGER ROD DIAMETER <u>Inches</u>
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8
14 and Over	20	1

3.7 LOW PRESSURE DUCT SUPPORT SCHEDULE:

- A. All horizontal ducts up to and including 40 inches in their greater dimension shall be supported by means of No. 18 U.S. gauge band iron hangers attached to the ducts by means of screws, rivets, or clamps and fastened to above inserts with toggle bolts, beam clamps or other approved means. Duct shall have at least one pair of supports 8' 0" on centers. Clamps shall be used to fasten hangers to reinforcing on sealed ducts.
- B. Horizontal ducts larger than 40 inches in their greatest dimension shall be supported by means of hanger rods bolted to angle iron trapeze hangers. Duct shall have at least one pair of supports 8' 0" on centers according to the following:

<u>Length</u>	<u>Angle</u>	<u>Rod Diameter</u>
4' 0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6' 0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8' 0"	2" x 2" x 1/8"	5/16"
10' 0"	3" x 3" x 1/8"	3/8"

- C. Vertical ducts shall be supported where they pass through the floor lines with 1 1/2" x 1 1/2" x 1/4" angles for ducts up to 60." Above 60", the angles must be increased in strength and sized on an individual basis considering space requirements.

3.8 MEDIUM PRESSURE DUCT SUPPORT SCHEDULE:

- A. All horizontal rectangular ducts shall have duct hanger requirements as follows:

Max Duct Dimen.	Steel Rod	Minimum Hanger Size		Min # of Hangers	Trapeze Size
		Galvanized Steel Strap Width	Max Spacing		
0 through 18"	--	1" x 16 ga.	10'	2	--
19" through 36"	--	1" x 16 ga.	10'	2	--
37" through 60"	3/8"	1" x 16 ga.	8'	2	2" x 2" x 1/4"
61" through 120"	3/8"	1-1/2" x 12 ga.	8'	2	2" x 2" x 1/4"
121" through 240"	3/8"	--	4'	3	2-1/2" x 2-1/2" x 3/16"

- B. All horizontal round ducts shall have ducts hangers spaced 10' 0" maximum with requirements as follows:

<u>Duct Diameter</u>	<u>Min. Hanger Size</u>	<u>No. Hangers</u>	<u>Hanger Ring Size</u>
Up through 18"	1" x 16 gauge	1	1" x 16 ga.
19" to 36"	1" x 12 gauge	1	1" X 12 ga.
37" to 50"	1-1/2" x 12 gauge	1	1-1/2" x 12 ga.
51" to 84"	1-1/2" x 12 gauge	2	Support Bracing Angle

3.9 DUCT HANGERS - GENERAL NOTES (ALL PRESSURES)

- A. Hanger straps on duct width of 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the side.
- B. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8" bolts minimum.
- C. Use 3/8" minimum bolts for securing duct hanger to band straps.
- D. All round ducts shall be supported within 3 feet of all horizontal or vertical turns.

END OF SECTION 23 05 29

SECTION 23 05 48 – VIBRATION ISOLATION

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. 23 00 00 -- Basic Mechanical Requirements
 - B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
 - C. 23 05 53 -- Mechanical Identification
- 1.2 WORK INCLUDED
- A. Vibration isolation
- 1.3 SCOPE OF WORK:
- A. Furnish and install all labor, materials, equipment tools and service and perform all operations required in connection with or properly incidental to the construction of complete system of vibration and noise control, as indicated on the Drawings, reasonably implied therefrom or as specified herein, unless specifically excluded.
- 1.4 REFERENCES
- A. ASHRAE - Guide to Average Noise Criteria Curves
- 1.5 QUALITY ASSURANCE
- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition
- 1.6 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 23 00 00.
 - B. Indicate inertia bases on shop drawings.
 - C. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.
 - D. Submit manufacturer's installation instructions under provisions of Section 23 00 00.
- 1.7 CERTIFICATES
- A. Submit a certificate from the manufacturer that isolators are properly installed and properly adjusted to meet or exceed specified requirements.
- 1.8 INTENT OF RESPONSIBILITY:
- A. It is the intent of this specification to provide for vibration isolation supports for all equipment, piping, and ductwork as set out below. The transmission of perceptible vibration, structural borne noise, or objectionable air borne noise to occupied areas by equipment installed under this contract will not be permitted. The Contractor shall be held responsible for installing the vibration isolators as specified herein or shown on the drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas. The isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria, and one which can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.
 - B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier who will be responsible for adequate coordination of all phases of this work. Concrete housekeeping pads and inertia bases shall be included as part of mechanical work. Pads under electrical gear shall be included as part of electrical work. The concrete work shall meet the requirements specified in the General Contract Specifications.

- C. The Contractor shall furnish complete submittal data, including Shop Drawings, which shall indicate the size, type, and deflection of each isolator; and the supported weight, disturbing frequency, and efficiency of each isolator proposed; and any other information as may be required for the Architects and Engineers to check the isolator selection for compliance with the specification. All steel bases and concrete inertia bases shall be completely detailed, and shall show completely any reinforcing steel that may be required to provide a rigid base for the isolated equipment. Further, the submittal data shall indicate, clearly, outlined procedures for installing and adjusting the isolators and bases mentioned above.
- D. The vibration isolation manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be required to assure correct and complete installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation and before acceptance by the Owner, the isolation manufacturer or his qualified representative, in company with the Architect or his designated representative, shall make a final inspection and submit his report to the Architects and Engineers, in writing, certifying the correctness of the installation and compliance with approved submittal data. Any discrepancies or maladjustments found shall be so noted in the report. Should any noise or vibration be objectionable to the Owner, Architect, or Engineer, a field instrumentation test and measurement must be made to determine the source, cause, and path of any such disturbance. Any variation or noncompliance with these specification requirements is to be corrected by the installing contractor in an approved manner.

PART 2 -

2.1 MANUFACTURERS:

- A. Vibration isolation devices shall be as manufactured by Vibration Mountings & Controls Inc (VMC), Kinetics Noise Control, or approved equal.

2.2 GENERAL DESIGN FEATURES:

- A. All vibration isolators and bases furnished by the Contractor shall be designed for and treated for resistance to corrosion.
- B. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc-electroplated or cadmium plated. Structural bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
- C. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized, or zinc-electroplated and shall have a coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel.
- D. Required spring deflections for isolators supporting various items of equipment are shown on the Drawings or tabulated elsewhere in these specifications, but in no case shall be less than one inch. The springs shall be capable of 30% over-travel before becoming solid.
- E. Where height-saving brackets for side mounting of isolators are required, the height-saving brackets shall be designed to provide for an operating clearance of 2" under the isolated structure, and designed so that the isolators can be installed and removed when the operating clearance is 2" or less. When used with spring isolators having a deflection of 2-1/2" or more, the height-saving brackets shall be of the pre-compression type to limit exposed bolt length between the top of the isolator and the underneath side of the bracket.
- F. All isolators supporting a given piece of equipment shall limit the length of the exposed adjustment bolt between the top and base to a maximum range of 1" to 2".
- G. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.
- H. Isolators for equipment installed out-of-doors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind load of 55 PSF (pounds per square foot) applied to any exposed surface of the equipment without failure.

2.3 ISOLATOR TYPES:

- A. Type 1 - An adjustable, free-standing, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring(s) shall be rigidly attached to the mounting base plate and to the spring compression plate. The isolator shall be designed for a minimum Kx/Ky (horizontal to vertical spring rate) of 1.0. A Neoprene pad having a minimum thickness of 1/4" shall be bonded to the base plate. Base plates shall be sized to limit pad loading to 100 psi.
- B. Type 2 - An aluminum-housed, or cast iron housed, adjustable, spring mounting having telescoping top and bottom sections separated by resilient inserts of Neoprene or other suitable material to limit horizontal motion. The inserts shall be permanently lubricated to minimize vertical friction. Sheet or cast iron housings may be used if they are hot-dip galvanized after fabrication. A Neoprene pad having a minimum thickness of 1/4" shall be bonded to the base plate.
- C. Type 4 - A pad-type mounting consisting of two layers of 3/8" thick, ribbed or waffled, Neoprene pads bonded to a 16 gauge galvanized steel separator plate. Bolting not required. Pads shall be sized for approximately 20 to 40 psi load, or a deflection of 0.10" to 0.16".
- D. Type 5 - A spring hanger consisting of a rectangular steel box, coil springs, spring cups, Neoprene impregnated fabric washer, steel washer, and Neoprene insert designed to prevent metal to metal contact between the hanger rod and bottom of the hanger box. The hanger box shall be capable of supporting a load of 200% of rated load without noticeable deformation or failure.
- E. Type 8 - 1/4" thick closed cell Neoprene in sheets cut to fit penetrations, as required.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

- A. Install vibration isolators for motor driven equipment.
- B. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.
- C. Piping:
 - 1. Floor mounted supports shall have the same type of isolator or media as is used for the nearest isolated equipment connected to the piping.
 - 2. The pipe hanger system shall have provisions for all piping to be shimmed or blocked in place until all connections are made and the system filled with water; then, the isolators adjusted to support the weights, and the shim blocks removed.
 - 3. The first three support points from a piece of isolated equipment shall be of the positioning type and provide not less than the static deflection of the equipment isolators.
 - 4. All springs supporting piping shall be capable of an additional 1/2" deflection prior to complete compression and springs supporting vertical risers shall have provisions for limit stops.
- D. Resilient Sleeves:
 - 1. Resilient sleeves shall be provided at all points where equipment room walls, floors, or ceilings are penetrated by ducts, piping, or refrigerant line, etc.
- E. Fans and Air Handling Units:
 - 1. Such units shall have electrical flexible connections not less than 36" long and the flexible duct connections with a free length of not less than 8".

3.2 SCHEDULE OF ISOLATED EQUIPMENT:

- A. Tabulated below is a schedule of equipment on this project requiring vibration isolation and base isolators of the types listed above. Any equipment, system, construction or condition that may be altered, added, or changed; or that is not specifically considered herein or on the plans shall be treated in a manner that is set out for similar equipment system or construction in order to comply with the above requirements heretofore cited.

Equipment	Isolator Equipment Type	Isolator Deflection	Base Isolator Type
Fan Coil Units	4	0.1	-
Piping	5	1"	-
All piping and duct floor penetrations in equipment room	8	-	-

END OF SECTION 23 05 48

SECTION 23 05 53 – PIPING AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. Perform all Work required to provide and install Owner's equipment tags, fire damper tags, valve tags, stencils, and pipe markers indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Contractor shall make it possible for Owner's operations and maintenance personnel to readily identify the various pieces of equipment, valves, piping, ductwork, fire dampers etc., by marking them in accordance with this Specification.
- C. Clearly mark all items of equipment, including but not limited to, fans, pumps, fire dampers, and valves using equipment tags as specified in this Section. The tagged item of equipment shall correspond to the same number as shown on the Drawings and as listed in the Equipment Matrix.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide manufacturer's catalog literature for each product.
- B. Record Documents:
 - 1. Submit Equipment Matrix with Valve and Fire Damper schedules completed
- C. Operation and Maintenance Data:
 - 1. Manufacturer's Installation Instructions: Indicate special procedures and installation.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved [black] letters on light contrasting background color.

2.2 TAGS

- A. Manufacturers: Brady, Brimar or Seton. Other acceptable manufacturers offering equivalent products will be acceptable.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

- C. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 PIPE MARKERS

- A. Manufacturers: Brady, Brimar or Seton. Other acceptable manufacturers offering equivalent products will be acceptable.
- B. Color: Conform to ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.4 CEILING TACKS

- A. Manufacturers:
 - 1. Brady, Brimar or Seton. Other acceptable manufacturers offering equivalent products will be acceptable.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
 - 1. Yellow - HVAC equipment
 - 2. Red - Fire dampers/smoke dampers
 - 3. Green - Plumbing valves
 - 4. Blue - Heating/cooling valves

2.5 GENERAL:

- A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them. All items of equipment such as fans, pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings. For example, pumps will be identified as 3A, 3B, 3C, etc.; exhaust fans will be E-1, E-2, etc.; supply fans will be S-1, S-2, etc.

2.6 MECHANICAL:

- A. All items of mechanical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 3-ply, with black surfaces and white core. Engraving shall be condensed Gothic, at least 1/2" high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include but not be limited to the following:

	Exhaust Fans
Fan and Coil Units	
Air Conditioning Control	Miscellaneous – similar
Panels and Switches	and/or related Items

- 2.7 PIPING: PIPE MARKERS AND ARROW MARKERS ALSO SHALL BE PROVIDED ON BUT NOT LIMITED TO THE PIPING OF THE FOLLOWING SYSTEMS:

Primary Chilled Water Supply		
------------------------------	--	--

Primary Chilled Water Return		
Heating Hot Water Supply	Heating Hot Water Return	

2.8 ELECTRICAL:

- A. Nameplates to be 3 ply laminated plastic, a minimum of 3/32" thick, such that letters will be white on black background. Letters to be similar to Roman Gothic of a size that is legible and appropriate to the application. Attachment of nameplates to be by screws. Rivets or adhesives are not acceptable.
- B. Electrical equipment to be identified includes: All switchgear, distribution panels, transformers, motor control centers, panelboards, disconnect switches, starters, contactors and time switches.
- C. Nameplates on distribution panels, motor control centers and panelboards to give voltage characteristics.

Example:

PANEL LA
 120/208V, 3 PH, 4 W
 SERVED FROM "MSBA".

- D. Individual circuit breakers in distribution panels, individual units in motor control centers, disconnecting means, and motor starters, are to include nameplates showing the load served.
- E. Branch circuit panelboards to have neatly typed circuit directories behind clean plastic. Identify circuits by room numbers. Use room numbers finally selected by the Owner's Representative; not necessarily those given on contract Drawings. If a circuit serves more than one room, list each room. Spares and spaces are to be indicated with erasable pencil; not typed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 9 for stencil painting.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Division 9.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify thermostats relating to terminal boxes or valves with nameplates.

- H. Identify valves in main and branch piping with tags.
- I. Identify air terminal units and radiator valves with numbered tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Provide ceiling tacks to locate valves, dampers or other concealed equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING SERVICES

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS CONTAIN INFORMATION REQUIRED TO FULFILL THE REQUIREMENTS OF THIS SECTION:

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 06 20 – Hydronic Specialties
- C. 23 09 23 – Direct Digital Controls
- D. 23 31 00 – Ductwork
- E. 23 33 00 – Ductwork Accessories
- F. 23 34 16 - Fans
- G. 23 36 00 – Air Terminal Units (VAV)
- H. 23 37 00 – Air Inlets and Outlets
- I. 23 73 00 – Air Handling Units (up to 10,000 cfm)
- J. 23 73 23 – Air Handling Units

1.2 SUMMARY

- A. TESTING, ADJUSTING AND BALANCING (TAB) OF THE AIR CONDITIONING SYSTEMS AND RELATED ANCILLARY EQUIPMENT WILL BE PERFORMED BY AN IMPARTIAL, TECHNICALLY QUALIFIED TAB FIRM SELECTED AND EMPLOYED BY THE OWNER, SEPARATE AND APART FROM THE CONSTRUCTION CONTRACT.
- B. The firm shall be capable of performing the services specified at the location of the facility described within the time specified, of preparing and submitting the detailed report of the actual field work performed, and following up the basic work as may be required.

1.3 QUALIFICATIONS

- A. The Firm shall be one which is organized to provide professional services of this specified type in the State of Texas and as a minimum shall have one (1) professional engineer licensed in the State of Texas, with current registration, to perform such professional services. This engineer shall be personally responsible for developing the job site data as required in the test procedures outlined in these Specifications.
- B. The Firm shall have operated a minimum of five (5) years under its current Firm name, and shall be in good standing with the State of Texas, Franchise Tax Board. The firm shall submit their full incorporated name, Charter Number and Taxpayer's I.D. Number for proper verification of the firm's status.
- C. The Firm shall be capable of providing a performance bond, by a bonding company licensed to do business in the State of Texas, if determined by the Owner that such a bond is required. The amount of the bond which may be required shall be equal to the cost of the proposal submitted, or in the case of more than one proposal, the sum of all such proposals and any awarded work in progress.
- D. All personnel used on the job site shall be either professional engineers or certified TAB engineering technicians, who shall have been permanent, full time employees of the firm for a minimum of six (6) months prior to the start of work for this specific project.
- E. The TAB firm shall submit biographical data on the supervising Professional Engineer, the individual proposed who will directly supervise the TAB work, as well as other personnel scheduled to perform the technical work under the contract. It shall also submit a background record of at least five years of specialized experience in the field of air hydronic system balancing, and shall possess properly calibrated instrumentation. The supervisory personnel for the TAB firm shall be registered engineers in the mechanical field.

1.4 REFERENCES

- A. AABC - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Seventh Edition.
- B. ASHRAE - 2015 HVAC Applications Chapter 34: Testing, Adjusting and Balancing.
- C. ANSI/ASHRAE Standard 111-2008 - Practices for Measurement, Testing, Adjusting and Balancing of Buildings, Heating, Ventilation, Air Conditioning and Refrigeration Systems.

1.5 DOCUMENTS

- A. The TAB firm shall, as a requirement of the TAB contract, arrange with the Architect to compile one set of mechanical specifications, all pertinent change orders, addenda and the following:
 - 1. One complete set of Drawings less the structural sheets.
 - 2. One set of mechanical floor plans of the conditioned spaces. These Drawings shall be blue or black on light background reproductions to facilitate marking.
- B. Approved submittal data on equipment installed, and related changes as required to accomplish the test procedures outlined in Paragraphs 1.06 through 1.10 of this Specification will be available through the Construction Inspector.

1.6 RESPONSIBILITIES OF THE TAB FIRM

- A. The TAB personnel shall check, adjust, and balance the components of the air conditioning system which will result in optimal noise, temperature, water flow and airflow conditions in the conditioned spaces of the building while the equipment of the system is operating economically. This is intended to be accomplished after the system components are installed and operating as provided for in the contract documents. It is the responsibility of the Mechanical Contractor to place the equipment into service. Variable air volume systems shall be balanced in accordance with AABC Standard, Seventh Edition.
- B. Liaison and Early Inspection:
 - 1. The TAB firm personnel on the job shall act as liaison between the Owner, Architect and Contractor. The following reviews (observations) and tests shall be performed by the TAB Agency:
 - a. During the design for Design Development (DD) and for two (2) Construction Document (CD) design stage submittals, at minimum, and before the documents are finalized, review the mechanical drawings and specifications for balance-ability and provide commentary.
 - b. During construction, at a minimum review HVAC submittals such as: Hydronic Specialties, Direct Digital Controls, HVAC Pumps, Steam and Condensate Piping Specialties, Ductwork, Ductwork Accessories, Fans, VAV and Fan Powered Boxes, Air Inlets and Outlets, Heat Exchangers, Air Handling Units, Terminal Heat Transfer Units, etc., that pertain to balance-ability and commissioning work. The TAB Consultant shall participate as a member of the Commissioning Team.
 - c. Allow for a fixed number of trips to the project site, over and above those required for testing and balancing for inspection of installation of the mechanical piping systems, ductwork, temperature controls mechanical equipment and other component parts of the heating, air conditioning and ventilating systems during the construction stage. These inspections shall be made prior to and/or at the above ceiling inspection. Written commentary will be provided to the Resident Construction Manager (RCM) or Construction Inspector (CI) of each observation.
 - d. Test and inspect one (1) 8" single duct terminal box for performance capability and leakage as described in Section 23 36 00 or 23 36 10. The shipment of the box to the TAB Agency's lab will be at the manufacturer's cost and the test period will be for three (3) weeks (maximum) from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason the second test will be at the Contractor's cost and the time allowed will restart when the box is received at the TAB Agency.

- e. Test and inspect one (1) 8" dual duct box for performance capability and leakage as described in Section 23 36 00. The shipment of the box to the TAB Agency's lab will be at the manufacturer's cost and the test period will be for three (3) weeks (maximum) from receipt of the box. Submittal data will not be approved until box testing passes. If the sample box is rejected for any reason the second test will be at the Contractor's cost and the time allowed will restart when the box is received by the TAB agency.
 - f. Test 10% of the single and dual duct boxes for casing and damper leakage when the shipment arrives at the project site. All testing (except for the initial boxes) shall be performed on site. Boxes requiring re-testing will be charged to the Contractor at the unit price provided to the Owner.
 - g. Testing of Air Handling Units (AHU): the TAB Consultant shall witness AHU casing deflection test at the AHU factory and AHU casing leakage testing in the field at the project site.
 - h. Test one (1) lab configuration including fume hood with air valve, general exhaust air with air valve and supply air with air valve for performance capability through a full range of inlet pressures. The tracking capability of the exhaust air versus the supply air will be with the submitted hood sash fully open and as the sash is closed in 2" increments until fully closed. Track the three (3) valves' response time in relation to sash movement and the lab differential.
2. During the balancing process, as abnormalities and malfunctions of equipment or components are discovered by the TAB personnel, the RCM and Construction Inspector shall be advised in writing so that the condition can be corrected by the Mechanical Contractor. The written document need not be formal, but must be clear, complete and legible. Data from malfunctioning equipment shall not be recorded in the final TAB report. The TAB firm shall not instruct or direct the Contractor in any of the work, but will make such reports as are necessary to the Owner.

1.7 FINAL AIR BALANCE

- A. General: When systems are complete and ready for operation, the TAB Consultant will perform a final air balance for all air systems and record the results. The supply, return, outside and exhaust air volume for each air handling unit, supply fan and exhaust fan and the supply, exhaust or return air volume for each distribution device shall be adjusted to within +5% of the value shown on the drawings. Air handling unit and fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit. Air distribution device volume shall be adjusted using the spin-in tap damper for flexible duct connected devices or the damper-in-duct tap to air device. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The general scope of balancing by the TAB Consultant will include, but is not limited to, the following:
 1. Filters: Check air filters and filter media and balance only system with essentially clean filters and filter media. The Division 23 Contractor shall install new filters and filter media prior to the final air balance.
 2. Blower Speed: Measure RPM at each fan or blower to design requirements. Where a speed adjustment is required, the Division 23 Contractor shall make any required changes.
 3. Ampere Readings: Measure and record full load amperes for motors.
 4. Static Pressure: Static pressure gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan. These readings shall be measured for this report at the furthest air device or terminal unit from the air handler supplying that device and recorded. Static pressure readings shall also be provided for systems which do not perform as designed.
 5. Equipment Air Flow: Adjust and record exhaust, return, outside and supply air CFM (s) and temperatures, as applicable, at each fan, blower and coil.
 6. Coil Temperatures: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and HVAC terminal unit. At the time of reading record water flow and entering and leaving water temperatures (In variable flow systems adjust the water flow to design for all the above readings).
 7. Zone Air Flow: Adjust each zone VAV Terminal Box serving an AHU, each HVAC terminal unit and AHU for design CFM.

8. Outlet Air Flow: Adjust each exhaust inlet and supply diffuser, register and grille to within +5% of design air CFM. Include all terminal points of air supply and all points of exhaust. Note: For Labs and Rooms that are negative exhaust air flow shall be set to design +10% and supply to design -5%. Positive areas will have opposite tolerances.
9. Pitot Tube Traverses: For use in future troubleshooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts shall have air velocity and volume measured and recorded by the traverse method. Provide a description of locations of these traverse test stations on the sheet containing the data.
10. Maximum and minimum air flow on terminal boxes.

1.8 FINAL CHILLED AND HEATING HOT WATER BALANCE

- A. General: When systems are completed and ready for operation, the TAB Consultant will perform a final water balance for each chilled and hot water system. The general scope of balancing by the TAB Consultant will include, but not be limited to, the following:
1. Adjusted System Tests: Adjust balancing valves at each coil and heat exchanger for design flow, +5%. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps and GPM flow from pump curve. Permanently mark the balanced position for each valve (Note: If discharge valves on the pumps are used for balancing record the head being restricted by the valves).
 2. Temperature Readings: Read and record entering and leaving water temperature at each water coil, converter and heat exchanger. Adjust as necessary to secure design and conditions. Provide final readings at all thermometer well locations.
 3. Pressure Readings: Water pressure shall be recorded at all gauge connections. Pressure readings at coils and pumps shall be related to coil and pump curves in terms of GPM flow through flow measuring status, if provided and installed, at each air handler. The flow of water through all water coils shall be adjusted by manipulating valves until the rated pressure drops across each coil is obtained and total water flow is verified by flow measuring status. For coils equipped with 3 way valves, the rated pressure drop shall first be adjusted through the coils. The bypass valve shall then be adjusted on each coil until an equal pressure drop between supply and return connections is the same as with the flow through the coil.
 4. Ampere Readings: Reading and record full load amperes for each pump motor.

1.9 TESTING OF TEMPERATURE CONTROL SYSTEMS

- A. In the process of performing the TAB work, the TAB Agency shall:
1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.
 2. Verify that all control devices are properly connected.
 3. Verify that all dampers, valves and other controlled devices are operated by the intended controller.
 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions. This includes terminal boxes and fire/smoke dampers.
 6. Observe that all valves are properly installed in the piping system in relation to direction of flow and location.
 7. Observe the calibration of all controllers.
 8. Verify the proper application of all normally opened and normally closed valves.
 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 10. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Should an adjustment of the installation be required, the TAB Consultant will provide a recommendation to the RCM and/or CI to coordinate with the Controls subcontractor to resolve as required for proper operation.
 11. Verify that the sequence of operation for any control mode is in accordance with approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 12. Verify that all controller setpoints meet the design control sequence..

13. Check all dampers for free travel.
14. Verify the operation of all interlock systems.
15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.

B. A systematic listing of the above testing and verification shall be included in the final TAB report.

1.10 REPORTS

- A. The activities described in this section shall culminate in a report to be provided on three (3) CDs and one (1) individually bound printed copy to the RCM. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the reports must have been made onsite by the permanently employed technicians or Engineers of the firm.
- C. TAB personnel shall submit copies of preliminary field measurements on data sheets tabulated each day to the Commissioning Authority.
- D. Submit reports on forms from the AABC manual approved by the Owner & Engineer which will include the following information as a minimum:
 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - i. UT System Project Identification Number
 2. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration date
 - g. What test instrument was used for
 3. Fan Data (Supply and Exhaust)
 - a. Identification/location
 - b. Manufacturer
 - c. Model
 - d. Airflow, specified and actual
 - e. Total static pressure (total external), specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
 4. Return Air/Outside Air Data (If fans are used, same data as for 3 above)
 - a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Return air temperature
 - f. Outside air temperature

- g. Required mixed air temperature
- h. Actual mixed air temperature
- 5. Electric Motors
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. RPM
 - e. Service factor
 - f. Starter size, heater elements, rating
- 6. V-Belt Drive
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center-to-center distance, maximum, minimum and actual
- 7. Duct Traverse
 - a. System zone/branch/location
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 8. Air Monitoring Station Data
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
- 9. Air Distribution Test Sheet
 - a. Air terminal mark number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
- 10. Cooling Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Water pressure flow, design and actual
 - j. Water pressure drop, design and actual

- k. Entering water temperature, design and actual
- l. Leaving water temperature, design and actual
- m. Air pressure drop, design and actual
- 11. Heating Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Water flow, design and actual
 - g. Water pressure drop, design and actual
 - h. Entering water or steam temperature, design and actual
 - i. Leaving water temperature, design and actual
 - j. Entering air temperature, design and actual
 - k. Leaving air temperature, design and actual
 - l. Air pressure drop, design and actual
- 12. Sound Level Report
 - a. Location (Location established by the design engineer)
 - b. NC curve for eight (8) bands - equipment off
 - c. NC curve for eight (8) bands - equipment on
- 13. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Interlocks
 - d. Safeties
 - 1) VFD Normal Operation
 - 2) VFD Bypass Operation
 - e. Alarms
 - f. Sequences of Operation

END OF SECTION 23 05 93

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SECTION 23 05 94 – SYSTEM PREPARATION FOR TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification
- D. Section 23 05 93 – Testing, Adjusting and Balancing

1.2 SUMMARY

- A. Perform all work required to prepare the building HVAC systems for testing, adjusting and balancing indicated by the Contract Documents as follows:
 - 1. Responsibilities of project contractor
 - 2. Preparation for balancing of air systems
 - 3. Preparation for balancing of hydronic and steam systems
- B. The scope of the TAB work as defined in Section 23 05 93 is indicated in order that the Contractor will be advised of the coordination, adjustment, and system modification which will be required under the project work in order to complete the Owner's requirements for final TAB. The TAB firm will not have a contractual relationship with any Contractor referred to herein, but will be responsible to the Construction Inspector and the Owner for the satisfactory execution of the TAB work. The Contractor in his original bid shall allow for the costs required to cover all work which may be required in the TAB phases as defined herein and as may be necessary for the completion of the TAB work as defined by the TAB firm.

1.3 RELATED SECTIONS

- A. Section 23 05 48 - Vibration Isolation
- B. Section 23 05 93 – System Testing, Adjusting and Balancing
- C. Section 23 06 20.13 - Hydronic Specialties
- D. Section 23 09 23 - Direct Digital Control Systems
- E. Section 23 31 00 - Ductwork
- F. Section 23 33 00 - Ductwork Accessories
- G. Section 23 34 16 - Fans
- H. Section 23 36 00 - Air Terminal Units (VAV)
- I. Section 23 37 00 - Air Inlets and Outlets
- J. Section 23 73 00 - Air Handling Units (Up to 10,000 CFM)
- K. Section 23 73 23 - Air Handling Units

1.4 SCOPE OF WORK

- A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by an impartial technically qualified TAB firm selected and employed directly by the Owner, separate and apart from the Construction Contract. However, the preparation for and corrections necessary for the Testing, Adjusting and Balancing of these systems, as described herein, are the responsibility of the Contractor.
- B. As a part of this project Construction Contract, the Contractor shall make any changes or replacements to the sheaves, belts, dampers, valves, etc. required for correct balance as advised by the TAB firm, at no additional cost to the Owner.

- C. The Contractor shall provide and coordinate the services of qualified, responsible Subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting and balancing period.
- D. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate said systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB. This length of time shall be subject to the approval of the Construction Inspector.
- E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The contractor shall allow adequate time for the testing and balancing activities of the owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- F. The Drawings and Specifications indicate valves, dampers and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor or the Construction Inspector shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

1.5 RESPONSIBILITIES OF THE PROJECT CONTRACTOR:

- A. The Contractor shall:
 - 1. Have the building and air conditioning systems in complete operational readiness for TAB work to begin.
 - 2. The contractor shall allow sufficient time for the TAB firm to perform his contracted work within the construction schedule. The contractor shall complete his work by systems or floors whichever is the most efficient for scheduling. After awarding of the contract and the contractor has developed a construction schedule, a TAB coordination meeting shall be held at the RCM's office with the TAB agency, the general contractor and his primary subcontractors (i.e. mechanical, electrical, building automation etc.) to develop a testing schedule for the project. The contractor shall submit copies of the proposed schedule two (2) weeks prior to this meeting to the RCM and TAB Agency.
 - a. Note: The hot water and chilled water systems must be 100% complete to balance. The air systems are pressure independent and can be balanced by floors, risers, systems, etc., but once the total system is complete the total flows and system tracking will require finalization. Lab certification will be performed when the building is 100% operational and balanced.
 - 3. Promptly correct deficiencies of materials and workmanship identified as delaying completion of TAB work.
 - 4. Be responsible for any added costs to the Owner resulting from his failure to have the building and air conditioning systems ready for TAB when scheduled, or from his failure to correct deficiencies promptly.
- B. Complete operational readiness of the building requires that construction status of the building shall permit the closing of doors, windows, ceilings installed, etc., to obtain simulated or projected operating conditions.
- C. Complete operational readiness of the air conditioning systems also requires that the following be accomplished:
 - 1. Air Distribution Systems:
 - a. Verify installation for conformity to design. All supply, return and exhaust ducts terminated and pressure tested for leakage as required by the Specification.
 - b. All volume, smoke and fire/smoke dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return and relief air shall provide tight closure and full opening, smooth and free operation. All manual volume dampers shall be set in the full open position prior to starting TAB.

- c. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices installed.
 - d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and/or sealed to eliminate excessive bypass or leakage of air.
 - e. All fans (supply, return and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating; record motor amperage and voltage on each phase at start-up and running, and verify they do not exceed nameplate ratings.
 - f. All single and/or double duct variable and constant volume terminal units ("mixing boxes") shall be installed and functional (i.e. controls functioning).
2. Water Circulating Systems:
- a. Check and verify pump alignment and rotation.
 - b. Open all valves to their full open position, close bypass stop valves. Set mixing valves to full-flow through systems components. After the system is flushed and checked for proper operation, remove and clean all strainers. The Contractor shall repeat the operation until circulating water is clean.
 - c. Record each pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating.
 - d. Verify that the electrical heater elements are of the proper size and rating.
 - e. In preparation of TAB all water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Systems shall be cleaned and flushed. Chemicals shall be added to closed systems to treat piping and inhibit corrosion.
 - f. Check and set operating parameters of the heat exchangers and control devices to the design requirements.
3. Automatic Controls:
- a. The Contractor shall schedule a meeting with the Engineer, Control Contractor, TAB firm and Owner's representative for a pre-submittal review to establish that their interpretations of the sequences of operation are correct.
 - b. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, dampers sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
 - c. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB firm and Control Contractor.
 - d. The Automatic Temperature Control Contractor and/or Energy Management System Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB agency that the Automatic Temperature Controls and Energy Management System are operational. The Automatic Temperature Contractor and/or Energy Management System Contractor shall provide technical support (technicians and necessary computers) to the TAB agency for a complete check of these systems.
4. Tabulated Data: The motor amperages, voltages shall be recorded showing "actual" and "nameplate" voltage and amperage and submitted and actual RPM. This applies to each piece of electrically driven air conditioning equipment in the system including supply and exhaust fans, fans of fractional horsepower, pumps, etc.
- D. Notification of System Readiness:
1. After completion of the work in Paragraph 1.5A through C above, the Contractor shall notify the Owner in writing, certifying that the work has been accomplished and that the building and the air conditioning systems are in operational readiness for testing, adjusting, and balancing. The Contractor shall include a copy of the tabulated data of Paragraph 1.5 C.4 above.
 2. The Owner will, in turn, notify the TAB firm of the readiness for balancing and forward copies of the Contractor's certification and the tabulated voltages and currents.

3. Should the TAB firm be notified as described above, and the TAB work commenced and the systems are found NOT to be in readiness or a dispute occurs as to the readiness of the systems, the Contractor shall request an inspection be made by duly appointed representative of the Owner, Architect, TAB firm and the Contractor. This inspection will establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for TAB services. Should the inspection reveal the TAB services notification to have been premature, all cost of the inspection and wasted work accomplished by the TAB firm shall be reimbursed to the appropriated parties by the Project Contractor.

1.6 RESPONSIBILITIES OF THE TAB FIRM

- A. Refer to Section 23 05 93 entitled "System Testing, Adjusting and Balancing."

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
NOT USED

END OF SECTION 23 05 94

SECTION 23 06 20 – HYDRONIC SPECIALTIES

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
 - A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
 - D. Section 23 20 10 – Piping, Valves, and Fittings
- 1.2 WORK INCLUDED
 - A. Strainers
 - B. Gauges and Gauge Connections
 - C. Thermometer and Thermometer Wells
 - D. Water Flow Measuring and Balancing System
- 1.3 RELATED WORK
 - A. Section 23 21 00 - Hydronic Piping
 - B. Section 23 22 00 – Steam and Steam Condensate Piping
- 1.4 REFERENCES
 - A. ANSI/ASME - Boilers and Pressure Vessels Code (BPVC)
- 1.5 REGULATORY REQUIREMENTS
 - A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section VIII for manufacture of tanks.
- 1.6 QUALITY ASSURANCE
 - A. Manufacturer: For each product specified, provide components by same manufacturer throughout.
- 1.7 SUBMITTALS
 - A. Submit shop drawings and product data under provisions of Section 23 00 00.
 - B. Submit shop drawings and product data for manufactured products and assemblies required for this project.
 - C. Include component sizes, rough in requirements, service sizes, and finishes. Include product description, model number and dimensions.
 - D. Submit inspection certificates for pressure vessels.
 - E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.
- 1.8 OPERATION AND MAINTENANCE DATA
 - A. Submit operation and maintenance data under provisions of Section 23 00 00.
 - B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.
- 1.9 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver products to site under provisions of Section 23 00 00.
 - B. Store and protect products under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.1 AUTOMATIC AIR VENTS

- A. Provide an automatic air vent, at the highest points of the chilled water systems and on the chilled water coils and elsewhere as shown on the Drawings, Armstrong No. 21AR or approved equal with a pressure rating of 250 psig. Provide shut-off valve to facilitate maintenance of air vent. Locate all air vents and their discharge lines in accessible locations, preferably clustered.

2.2 STRAINERS

- A. Each control valve for chilled water and heating water, and each pressure reducing valve assembly regardless of its size shall be preceded by a sediment strainer. The arrangement of these sediment strainers shall be such that the screens may be removed for cleaning with ease through a gasketed plug. Monel or stainless steel shall be used to fabricate the noncollapsible lapped screens, which shall contain no soldered joints.
- B. Sediment strainers shall be placed in piping systems wherever shown on the Drawings and at such other points as may be required for the removal of foreign material from the piping systems.
- C. In piping two inches (2") and smaller, strainers shall be Mueller 11M, Watts 77S, or approved equal wye-strainer. Strainers 2-1/2" and larger shall be Mueller 781 series, Watts 77F or approved equal wye-strainer.
- D. Strainers, 2" and smaller shall have a cast steel body, screwed ends, No. 20 mesh strainer, and screwed cap with bronze blow off valve (size to be determined by standard tap size in cap). Strainers, 2 1/2" and larger shall have a cast steel body, dielectric isolating type flanged ends where installed in copper lines, 0.125" perforated Monel or stainless steel strainer, and flanged cap with bronze ball blow off valve (size of blow off valve shall be determined by standard tap size in cap). All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.
- E. Full sized blow off valves shall be installed on all strainers in steam, condensate, chilled and hot water lines and a drain shall be installed from each valve to the nearest floor drain.

2.3 GAUGES AND GAUGE CONNECTIONS

- A. Furnish and install Ashcroft No. 1279A Duragauges on both suction and discharge sides of pumps, complete with Ashcroft No. 1095 lever handle shut-off cocks, and Ashcroft No. 1106B pulsation piston type dampeners, or approved equal. Porous type will not be accepted. Gauges shall have stainless steel movement and be accurate to 0.5%. Gauges shall be in PSI. Gauges shall have back connection when used on a panel; otherwise they shall have bottom connections. The graduation of the dials and the arrangement of the mechanisms shall conform to the pressure range details shown on the Drawings.
- B. Combination pressure or vacuum gauges shall be Ashcroft Duragauges Number 1279A, with an appropriate vacuum range, or approved equal. The accessories for these gauges shall conform to those prescribed for pressure gauges.
- C. Furnish and install, where noted or indicated on the accompanying Drawings or called for elsewhere in these Specifications, gauge connections complete with Ashcroft No. 1095 lever handle union shutoff cocks, or approved equal. All gauge connections shall be made up with brass pipe, nipples and brass screw fittings.

2.4 THERMOMETER AND THERMOMETER WELLS

- A. Furnish and install thermometers of not less than 9" scale complete with brass separable sockets with extension neck to allow for insulation of piping. These thermometers shall be red reading tube type with mercury in one piece glass tubes extending from top of scale to sensor, and shall be located so that they may be easily read. Field adjustable angle thermometers are acceptable. Thermometers shall in all cases be installed upright or at the proper angle to be read while standing on the floor. The wells for thermometers shall be located in vertical pipes where possible and when necessary in horizontal pipes they shall be installed in the side and not on the top of the pipe. They shall be Weksler Industrial Thermometers, or approved equal, with range of 0 to 100 degrees F. for chilled water, and 0 to 220 degrees F for hot water.
- B. Thermometer wells and thermometers shall be located where noted on the accompanying Drawings and where called for in other sections of the Specifications. Thermometer test wells only shall be installed in a vertical position in horizontal lines and at 45 degrees, in vertical lines to hold a fluid in the well.
- C. Thermometer test wells shall be 3/4" Weksler Thermal Wells, brass with stem of minimum length to extend beyond the mid-diameter of the pipe, 2-1/2" extension neck, and brass screw plug. Wells shall be suitable for use of industrial type thermometers.
- D. Indicating thermometers shall be placed in lines wherever shown on the Drawings. These thermometers shall be Weksler Industrial Thermometers having stainless steel separable sockets and scales of the range shown on the Drawings.
- E. Provide thermometer and thermowell assemblies, as described above, with one assembly each for the chilled water supply and return main pipes. Install the assemblies in close proximity to the RTDs that are provided for the chilled water BTU meter.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Support tanks inside building from building structure in accordance with manufacturer's instructions.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide manual air vents at entrance to all heating hot water coils, with a "cane" shaped discharge tube, positioned to permit draining to a portable receptacle.
- E. For automatic air vents in ceiling spaces or other concealed locations, extend vent tubing to nearest drain.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION 23 06 20

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SECTION 23 07 13 – DUCTWORK INSULATION

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 SECTION INCLUDES
- A. Ductwork insulation
 - B. Insulation jackets
- 1.3 RELATED SECTIONS
- A. Section 09 91 00 - Painting: Painting insulation jackets
 - B. Section 23 31 00 - Ductwork: Duct liner
 - C. Section 23 33 00 - Ductwork Accessories: Duct liner
- 1.4 REFERENCES
- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate
 - B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation
 - D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation
 - E. ASTM E84 - Surface Burning Characteristics of Building Materials
 - F. ASTM E96 - Water Vapor Transmission of Materials
 - G. NFPA 255 - Surface Burning Characteristics of Building Materials
 - H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
 - I. UL 723 - Surface Burning Characteristics of Building Materials
 - J. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 23 00 00.
 - B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
 - C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.
- 1.6 QUALITY ASSURANCE
- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.
- 1.7 QUALIFICATIONS
- A. Applicator: Company specializing in performing the work of this section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. In no instance shall ductwork insulation be stored outdoors or where subject to moisture damage.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.9 ENVIRONMENTAL REQUIREMENTS

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

PART 2 - PRODUCTS

2.1 INSULATION A:

- A. Three pound per cubic foot minimum density glass fiber semi-rigid board insulation with fiber perpendicular to the surface and with factory applied white foil reinforced vapor barrier jacket (ASJ). Insulation shall be equal to E.O. Woods Company "Rigid-Wrap".
- B. The insulation shall be secured to the ducts with mechanical fasteners; "Stick-clips", Graham Pins or Speed Clips, and shall be spaced approximately 12" on center on bottom of duct and where required elsewhere to hold insulation securely against the duct per the Insulation Manufacturer recommendations. Stick pins welded to ductwork are not acceptable.
 - 1. Insulation on the bottom of duct and on vertical sections shall be coated with an adhesive and pushed firmly against the ductwork as well as being secured with mechanical fasteners. Adhesives shall be approved by the insulation manufacturer for use with the insulation and shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. After insulation is in place, all joints and seams shall be sealed with Foster 30-90 white vapor barrier mastic (water based) applied over a 3" wide strip of Duramesh Glass Fabric. All protrusions through the vapor barrier shall be thoroughly sealed.
- D. On ducts that are reinforced with standing seams or angle iron stiffeners 1" and over in height, the Contractor shall apply a strip of fiberglass board 1" thick by 6" wide, sealing same to the other insulation with mastic.

2.2 INSULATION B:

- A. Three pound per cubic foot minimum density glass fiber rigid board insulation with factory applied white foil reinforced All Service Jacket (ASJ).
- B. Insulation B shall be applied as specified for Insulation A.
- C. Contractor at his option may substitute Insulation A where Insulation B is called for.

2.3 INSULATION C :

- A. Blanket insulation with a thermal conductivity (K) of 0.27 or less similar in construction to Owens-Corning Fiberglass Series one pound per cubic foot minimum density with foil reinforced Kraft (FRK) vapor barrier facing. Insulation shall be applied flat on the ductwork with all circumferential joints butted. longitudinal joints overlapped a minimum of 2" and per manufacturer's recommendations. Adhere insulation to metal with 4" strips of insulation bonding adhesive at 8" on center. On circumferential and longitudinal joints, the 2" flange of the facing shall be secured using 9/16" flare door staples applied 6" on center and taped with 4" wide fiberglass tape embedded in Foster 30-90 white vapor barrier Emulsion and covered with Foster 30-90 white vapor barrier Emulsion until the tape is completely covered. All pin penetrations or punctures in facing shall also be taped.

2.4 PROTECTIVE JACKETING

- A. Jacketing and fitting covers shall be 0.016" aluminum smooth as manufactured by Premetco or Childers. The jacket shall be pre-cut, pre-rolled and lapped a minimum of two inches (2") in all directions to shed water. The metal shall be secured at each joint with a minimum of one each 3/4" wide 0.020" aluminum or stainless steel band and seal. The metal jacketing and fitting covers shall be fabricated of 0.016" aluminum or stainless steel with a smooth finish.

2.5 SCOPE OF DUCT INSULATION

- A. All ductwork in the building except toilet exhaust and fume hood exhaust ducts shall be insulated externally unless specifically excluded. Only sound attenuated return ducting may be insulated internally, if specifically designated as such. Refer to section 23 33 00 for duct liner specifications.
- B. Where ducts are lined internally, (see Drawings for Scope) no exterior insulation will be required, except where specifically stated otherwise. Where internal and external insulation join, they shall lap at least 24 inches.
- C. Low pressure supply duct taps to ceiling diffusers shall be externally insulated including top of ceiling diffuser with 2" Insulation C.
- D. Flexible round ducts are specified in Section 23 31 00 as factory insulated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Finish with tape and vapor barrier jacket.
 - 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 3. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. For ductwork exposed in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.

- E. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.
- F. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- G. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the duct has been successfully leak tested. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable.
- H. Vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- I. Extreme care shall be taken in covering high and medium pressure (high and medium pressure ductwork shall be all ductwork between the fan discharge and all mixing boxes) ductwork to insure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these specifications are classified as high velocity ductwork.
- J. For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.
- K. The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer's recommendations.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 DUCT INSULATION SCHEDULE:

<u>Duct Type</u>	<u>Duct Location</u>	<u>Insulation Type</u>	<u>Insulation Thickness (inches)</u>	<u>R Value</u>	<u>Jacketing</u>
Supply Air (Hot or Cold) Round and Oval	Conditioned and plenum	A	2	6	ASJ
Supply (Hot or Cold) Air Rectangular	Conditioned and plenum	B	2	6	ASJ
Rectangular Return	Conditioned and plenum	None	0	0	
Rectangular Relief	Conditioned and plenum	B	2	6 (Note 1)	ASJ
Outside Air	Conditioned and plenum	B	2	6	ASJ

1. Relief air duct is insulated from the point where the duct exits the building 6' in the direction counter to airflow.

END OF SECTION 23 07 13

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SECTION 23 07 19 – PIPING INSULATION

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. 23 00 00 -- Basic Mechanical Requirements
- B. 23 05 29 -- Sleeves, Flashings, Supports and Anchors
- C. 23 05 53 -- Mechanical Identification

1.2 SECTION INCLUDES

- A. Piping insulation
- B. Jackets and accessories

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.

1.4 RELATED SECTIONS

- A. 23 00 00 General Mechanical Requirements

1.5 REFERENCES

- A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate.
- B. ASTM C177 Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- C. ASTM C195 Mineral Fiber Thermal Insulation Cement.
- D. ASTM C335 Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- E. ASTM C449 Mineral Fiber Hydraulic setting Thermal
- F. ASTM C518 Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation.
- H. ASTM C534 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- I. ASTM C547 Mineral Fiber Preformed Pipe Insulation.
- J. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation.
- K. ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- L. ASTM C585 Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- M. ASTM C921 Properties of Jacketing Materials for Thermal Insulation.
- N. ASTM D1056 Flexible Cellular Materials Sponge or Expanded Rubber.
- O. ASTM D2842 Water Absorption of Rigid Cellular Plastics.
- P. ASTM E84 Surface Burning Characteristics of Building Materials.
- Q. ASTM E96 Water Vapor Transmission of Materials.
- R. NFPA 255 Surface Burning Characteristics of Building Materials.
- S. UL 723 Surface Burning Characteristics of Building Materials.
- T. ASHRAE 90.1 – Energy Standard for Buildings Except Low Rise Residential Buildings

1.6 SUBMITTALS

- A. Submit under provisions of Section 23 00 00.
- B. Product Data: Provide product description, list of materials 'k' value, 'R' value, mean temperature rating, and thickness for each service, and locations.
- C. Samples: When requested, submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

- A. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84 89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- B. All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3"). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 23 00 00.
- C. All piping shall be insulated as indicated on the Drawings, as specified herein, and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- D. To be considered, alternate materials shall have equivalent thermal and moisture resistance of the specified materials.

1.8 QUALIFICATIONS

- A. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation.
- B. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation. The company performing the work of this section shall have a minimum of three years' experience specializing in the trade.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 23 00 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product thermal ratings and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. All insulation materials to be asbestos free.

PART 2 - PRODUCTS

2.1 TYPE C: PHENOLIC FOAM

- A. Phenolic Foam by ITW Trymer or equal with a “K” factor of 0.19 BTU-In/Hr.-degree F at 75°F.
 - 1. Rated maximum service temperature of 257°F.
 - 2. Maximum density of 3.75 lbs/ft³
 - 3. Compressive strength of 45 psi minimum when tested in accordance with ASTM C165.
 - 4. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
 - 5. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 - 6. Rated as noncombustible when tested in accordance with ASTM E136.
 - 7. Install product using manufacturer’s recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.
 - 8. Installation: As Type B, above.

2.2 TYPE E: CLOSED CELL ELASTOMERIC

- A. Closed cell elastomeric piping insulation with a “K” factor of 0.25 BTU-In/Hr.-degree F at 75 F as manufactured by Armacell or equal.
 - 1. Rated maximum service temperature of 220°F.
 - 2. Rated as 25 flame spread and 50 smoke developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102-M88 or NFPA 255.
 - 3. Certified to meet the requirements of ASTM C795 for use over stainless steel.
 - 4. Rated as noncombustible when tested in accordance with ASTM E136.
 - 5. Elastomeric products shall be supplied in a pre-slit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint.
 - 6. Install product using manufacturer’s recommended methods and accessories unless alternate methods are specified in Part 3 – Installation (General) or in this section.

PART 3 - INSTALLATION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer’s instructions in the absence of specific instruction herein.
- B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the “90°” position, with the seam lapped such that the lap is directed down.
- C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
- D. For insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
- E. If PVC fitting covers are used they shall have 25/50 rating.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.

3.3 INSERTS, SUPPORTS AND SHIELDS

- A. Application: Piping 3/4 inch diameter or larger for all systems except direct buried.
- B. Shields: Install between pipe hangers or pipe hanger rolls and inserts. Hangers shall be on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and the bottom of the insulated pipe for insulated pipes 3/4" and larger. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe. Shields shall be made of galvanized iron, or black iron painted on both sides with two coats of aluminum paint. Required metal shield sizes are as follows:

Nominal IPS	Metal Thickness of Shield	Lengths
up thru 2"	14 gauge	12"
thru 6"	12 gauge	16"
and above	10 gauge	20"

- C. Insert Location: Between support shield and piping and under the finish jacket.
- D. Insert Configuration: Minimum 2" inches longer than length of shield, of same thickness and contour as adjoining insulation; may be factory fabricated.
- E. Insert Material: Heavy density insulating material suitable for the planned temperature range, and the weight of the pipe.
- F. The shields at support points shall be secured with 1/2" x 0.016" stainless steel bands and seals.
- G. Finish insulation at supports, protrusions, and interruptions.
- H. In lieu of the above the following system of support may be used:
 1. At the pipe support positions, the insulation and vapor barrier shall be continuous and shall not be punctured by the support. The insulation at the support shall be the full circumference of 5lbs/ft³ phenolic foam material to withstand the bearing loads transmitted from the pipe to the support; it shall extend for at least 1" on either side of the support to allow sealing of the joints with the pipe insulation jacket.
 2. The load bearing insulation at the support shall be capable of withstanding the maximum static compressive loads generated by pipe supported at the centers shown in Table Variations: Pipe loads greater than those generated at the support centers shown in Table 1 shall be referred to the manufacturer to establish the length and density of the insulated support block. The support centers are based on the weight of Sch 80 pipe filled with water and covered with 1" thickness of 2.2 lbs/ft³ standard insulation including FSK/ASJ vapor barrier.
- I. Table 1: K Block Support Centers

Nominal Pipe Size (Inches)	3/4	1	1 1/4	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24
Max support centers (feet)																
Sch 80 pipe filled with water covered with 1" of Standard Insulation	6.5	6.5	6.5	10	10	10	10	10	14	14	14	20	20	20	20	20
Metal Saddle Gauge (Galvanized Steel)	22	22	22	20	20	20	16	14	14	14	14	14	114	14	14	14
Length of HLB Block (inches)	6	6	6	6	6	6	6	9	9	9	9	9	9	12	12	12

1. The Insulation at supports shall be Foamglas HLB Blocks. HLB Blocks shall be faced with factory applied FSK/ASJ vapor barrier and fitted with a galvanized steel 1800 saddle bonded to the bottom section of the HLB Block, for all pipe sizes 1 1/2" and larger.
2. The vapor barrier shall be completed by the use of a FSK/ASJ overlap and factory applied self-seal lap tape and sealed with vapor barrier adhesive.
3. At all support positions, other than those where the insulated pipe support block is surrounded by a clip or saddle in direct contact with the block, a block designed to accept the loads generated by the pipe shall be presented to the engineer for approval.
4. In all cases where roller supports are used the length of the insulation and the wearing plate where fitted shall extend beyond the limits of the pipe movement.

J. For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.

K. Self Sealing Lap and butt joints will not be acceptable as the only seal on piping insulation joints. Self Sealing Lap and butt joints may be utilized only if the joints are additionally secured with field applied vapor barrier adhesive (on piping Systems requiring vapor barriers) or staples and field applied adhesive (on piping system which do not require a vapor barrier jacket). Mechanical fasteners shall be used whenever possible to assure permanent installation.

L. Insulation minimum thickness shall be as scheduled; however, additional thickness shall be provided to prevent condensation on the cold surfaces and to provide a maximum exterior insulation surface of 140 degrees F on the hot surfaces.

M. Special Protection: All insulated piping in the mechanical rooms within 8'-0" of the floor shall be encased in a protective jacket, and where applicable, finish at top with nickel-plated brass flange plate with set screws or end joint sealing butt strips.

3.4 PAINTING

A. All exposed insulation shall be prepared to receive painting specified under Section 09 91 00.

3.5 INSULATION APPLICATION SCHEDULE

A. All insulation R-Values shall be the greater of what is scheduled below or required to meet ASHRAE 90.1-2013.

B. Where minimum scheduled thickness exceeds the thickness required to meet the minimum R-Value, provide the minimum scheduled thickness. Insulation Thickness depends upon insulation type used.

<u>Service</u>	<u>Pipe Dia. (Inches)</u>	<u>Fluid Temp (°F)</u>	<u>Min. R-Value (ft² °F-hr/BTU in)</u>	<u>Insulation Thickness (Inches)</u>		
				<u>Type C</u>		<u>Type E</u>
<u>Chilled Water</u>		<u><40</u>				
	<1"		3.2	1 ½"		
	1 to <1 1/2"		6.4	1 ½"		
	2" to <4"		5.7	2"		
FCU Condensate	<1"					1"

1. All insulation R-Values shall be the greater of what is scheduled above or required to meet ASHRAE 90.1-2013.

2. Use the following jacket types: All Service Jacket
3. Minimum 'R' does not consider water vapor transmission and condensation. Additional insulation and/or vapor retarders may be required to limit water vapor transmission and condensation under extreme conditions.
4. A minus 15 percent tolerance on the insulation performance listed shall be permitted for manufacturers' standard insulation systems.

END OF SECTION 23 07 19

SECTION 23 20 10– PIPING, VALVES AND FITTINGS

PART 1 - GENERAL

1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:

- A. Section 23 00 00 – Basic Mechanical Requirements
- B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
- C. Section 23 05 53 – Mechanical Identification

1.2 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves

1.3 RELATED SECTIONS

- A. Division 02 - Excavating
- B. Division 08 – Access Doors and Frames
- C. Division 09 – Painting
- D. Section 23 05 16 – Expansion Compensation
- E. Section 23 05 48 – Vibration Isolation
- F. Section 23 07 19 – Piping Insulation
- G. Section 23 21 00 – Hydronic Piping
- H. Section 23 06 20.13– Hydronic Specialties

1.4 REFERENCES

- A. ASME – Boiler and Pressure Vessel Code (BPVC)
- B. ASME BPVC Sec. IX – Welding and Brazing Qualifications
- C. ASME B16.1 – Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
- D. ASME B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300
- E. ASME B16.4 – Grey Iron Threaded Fittings: Classes 125 and 250
- F. ASME B16.5 – Pipe Flanges and Flanged Fittings NPS ½ through 23 Metric/Inch Standard
- G. ASME B16.9 – Factory-Made Wrought Buttwelding Fittings
- H. ASME B16.18 – Copper Alloy Solder Joint Pressure Fittings
- I. ASME B16.22 – Wrought Copper and Bronze Solder-Joint Pressure Fittings
- J. ASME B16.26 – Copper Alloy Fittings for Flared Copper Tubes
- K. ASME B16.34 – Valves Flanged, Threaded, and Welding End
- L. ASME B31.1 – Power Piping
- M. ASME B31.3 – Process Piping
- N. ASME B31.9 – Building Service Piping
- O. ASTM A47 - Ferric Malleable Iron Castings
- P. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

- Q. ASTM A105 – Standard Specification for Carbon Steel Forgings for Piping Applications
 - R. ASTM A106 – Specification Standard for Seamless Carbon Steel Pipe for High-Temperature Service
 - S. ASTM A126 – Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings
 - T. ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe
 - U. ASTM A181 – Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
 - V. ASTM A182 – Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
 - W. ASTM A234 - Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - X. ASTM B16 – Standard Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines
 - Y. ASTM B32 – Standard Specification for Solder Metal
 - Z. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes
 - AA. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes
 - BB. for Steam or Valve Bronze Castings
 - CC. ASTM B75 - Standard Specification for Seamless Copper Tube
 - DD. ASTM B88 - Standard Specification for Seamless Copper Water Tube
 - EE. ASTM B99 – Standard Specification for Copper-Silicon Alloy Wire for General Applications
 - FF. ASTM B148 – Standard Specification for Aluminum-Bronze Sand Castings
 - GG. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
 - HH. ASTM B302 – Standard Specification for Threadless Copper Pipe (TP), Standard Sizes
 - II. AAA.AWS A5.8 - Brazing Filler Metal.
 - JJ. MSS SP-25 – Standard Marking System for Valves, Fittings, Flanges, and Unions
 - KK. NCPWB - Procedure Specifications for Pipe Welding
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 23 00 00.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 23 00 00.
 - B. Record actual locations of valves, etc. and prepare valve charts.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 23 00 00.
 - B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.8 QUALITY ASSURANCE
- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

- C. Welder's Certification: In accordance with ASME BPVC Sec. IX. Submit welder's certifications prior to any shop or field fabrication. Welder's certifications shall be current within six months of submission.
- D. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum of three years' documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.12 EXTRA MATERIALS

- A. Furnish under provisions of Section 23 00 00.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.1 STEEL PIPING:

- A. Section applies to all piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: chilled water, hot water, steam, and steam condensate.
- B. Pipe: Unless otherwise indicated, chiller and boiler plant piping shall be Schedule 40, and underground and building piping shall be Standard weight, Grade A or B, seamless black steel pipe conforming in all details to Standard ASTM Designation A53, A106, and A135, latest revisions. Steam condensate shall be Schedule 80.
- C. Fittings:
 - 1. All weld fittings shall be domestic made wrought carbon steel butt-welding fittings conforming to ASTM A234 and ASME/ANSI B16.9, latest edition, as made by Weldbend, Tube Turns, or Hackney Ladish Inc. Attach only to pipe with a hole for the entire length. Each fitting shall be stamped as specified by ASME/ANSI B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random. Fittings which have been machined, remarked, printed, or otherwise produced domestically from non-domestic forgings or materials will not be acceptable. Each fitting is to be marked in accordance with MSS SP-25. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
 - 2. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Grinnell Company, Crane Company, or Walworth Company manufacture (Class 300 for unions).

D. Fabrication:

1. Piping shall be fabricated according to the latest ASME/ANSI B31 Code for Pressure Piping. Welded piping and fittings in chiller and boiler plants shall be fabricated in accordance with ASME/ANSI Standard B31.1 – Power Piping. Direct buried piping mains shall be fabricated in accordance with ASME/ANSI Standard B31.3 – Process Piping. Standard B31.9 – Building Services Piping may be used within buildings. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
2. Ensure complete penetration of deposited metal with base metal in welds. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size, and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
3. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
4. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
5. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
6. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
7. In no cases shall Schedule 40 pipe be welded with less than three passes, including one stringer/root, one filler, and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler, and one lacer. In all cases, the weld must be filled before the cap weld is added.
8. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

E. Weld Testing:

1. All welds are subject to inspection, visual, X-ray and/or Ultrasound, for compliance with specifications. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing. Initial visual and X-ray inspections will be provided by the owner. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1, B31.3, and B31.9, due to the discovery of poor, unacceptable, or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the ASME/ANSI B31 Code for Pressure Piping, current edition.

2.2 VALVES:

- A. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project. All valves shall be located such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings.
- B. All bronze and iron body gate and globe valves shall be the product of one manufacturer for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacture, etc.
- C. All bronze valves used in circulating systems and steam systems (low and medium pressure) shall be Class 150 SWP. Bronze valves used in high pressure steam systems shall be Class 300 SWP. Iron valves used for low and medium pressure steam systems shall be Class 125. Iron valves used for high pressure steam systems shall be Class 250. [Austin Campus Only: Gate valves 2" or smaller used in low pressure steam systems shall be Class 300 SWP. Gate valves 2 1/2" or larger used in low pressure steam systems shall be Class 150.]
- D. All gate and globe valves shall be union bonnet design.
- E. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials. Alloys used in all bronze ball, gate, globe, check, or angle valves shall contain no more than 15% zinc. No yellow brass valves will be allowed.
- F. Class 300 valves shall be constructed of all ASTM B61 composition.
- G. All iron body valves shall have the pressure containing parts constructed of ASTM A126 class B iron. Stem material shall meet ASTM B16 Alloy 360, ASTM 371 Alloy 876 silicon bronze, ASTM B584, or their equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing. [Austin Campus only: All iron body gate valves shall have the body constructed of ASTM A395 ductile iron.]
- H. All cast steel body valves shall have the pressure containing parts constructed of ASTM A216-GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16.34. Stems shall meet ASTM designation A182-F6 chromium stainless steel. Wedges on gate valves may be solid or flexible type and shall meet ASTM A182-F6 chromium stainless steel on valves from 2" to 6". Sizes 8" and larger may be A216-WCB with forged rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13% chromium A182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or ductile iron ASTM A536.
- I. All forged steel body valves shall have the pressure containing parts constructed of ASTM A105, grade 2 forged carbon steel. Seat and wedges shall meet ASTM A182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16.34 pressure-temperature rating.
- J. All valves shall be repackable under pressure, with the valve in the full open position. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A126 Class B, gray iron hand wheels.
- K. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion, then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.

- L. Valves 12" and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 to accommodate a drain valve and equalizing by-pass valve assembly.
- M. Balancing and/or shutoff valves for hot water systems 2" inches and smaller shall be three piece, full port, bronze body ball valves with stainless steel ball and stem. They shall have PTFE seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use on insulated lines.
- N. Shutoff valves for chilled water 2" and smaller shall be two piece, full port, bronze body ball valves with stainless steel ball and stem. They shall have PTFE seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use on insulated lines.
- O. All balancing and/or shutoff valves 2 1/2" and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling.
- P. All balancing and/or shutoff valves must be capable of providing a bubble tight seal at 200 psi for valves up to 12", and 150 psi for larger valves, when used for end of line service, without requiring the installation of a blind flange on the downstream side.
- Q. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi. Liners shall be resilient material suitable for 225 °F temperature and bodies of ductile iron. Butterfly valves 2 1/2" through 6" shall have lever handles which can be set in interim positions between full open and full closed. Butterfly valves 8" and larger, and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators with malleable iron handwheel or crank.
- R. Check Valves for Water Systems: Valves 2" and smaller shall have bronze bodies and a regrinding disc and seat with screw-in cap. Valves 2 1/2" and larger shall have iron bodies and be non-slam wafer type with stainless pins and springs, and bronze or stainless steel plates.

2.3 STANDARDS OF QUALITY FOR VALVES

Size	Service	Media	Class	Milwaukee	Nibco	Crane Co. Stockham or as noted
2" & smaller	Gate Valve	L.P. Steam	150	--	T-134	B-120
2-1/2" & larger	Gate Valve	L.P Steam	125	F-2885A	F-617-O	G-623
* 2" & smaller	Ball Valve for Shutoff	Recirculating chilled water	150	BA-400S	T-585-70-66	Apollo 82-140
* 2" & smaller	Ball Valve for Shutoff	Recirculating hot water	150	BA-300S	T-595-Y-66	Apollo 77-140
2" & smaller	Globe & Balancing Valve	Chilled Water, Hot Water	150	590T	T-235-Y	B-22T
2-1/2" & larger	Globe & Balancing Valve	Chilled Water, Hot Water	125	F-2981A	F-718-B	G-512

* Requires extended stem in insulated lines.

1. Note: Valves 8" and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operators.

- B. Provide and install two-piece unions at proper points to permit removal of pipe, valves and various equipment and/or machinery items without injury to other parts of the system. No unions will be required in welded lines or lines assembled with solder joint fittings except at all valves, equipment items, machinery items and other special pieces of apparatus. Unions 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2 1/2" and larger shall be ground flange unions. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.
- C. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to EPCO.
- D. In all water lines where the material of the pipe is changed from ferrous to copper or brass, a two-piece dielectric union shall be used at the transition.

2.4 FLANGES:

- A. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A181 Grade I or II or ASTM A105-71 as made by Tube Turns or Hackney Ladish Inc. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9, and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Allthread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and be rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and be rated at least ANSI Grade I.
- B. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.
- C. Flange Gaskets
 - 1. Gaskets shall be placed between the flanges of all flanged joints.
 - 2. Gaskets for steam piping - All steam flange joints shall use Flexitallic Class 150 spiral wound for low pressure applications and Flexitallic Class 300 spiral wound gaskets for medium or high pressure applications. Raised and flat face flange gaskets shall be Flexitallic compression gauge (CG) style. External ring shall be Type 304 stainless steel and color coded yellow. Filler material shall be Flexite Super and color coded with pink stripe. Equivalentents may be submitted with all design data so that an evaluation of the gasket can be made.
 - 3. Gaskets for all other applications: Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
 - 4. Spares - Contractor shall provide ten spares for every flange size and rating.
- D. Flange Bolt Installation:
 - 1. Bolt Lubrication: Bolts shall be well lubricated with a heavy graphite and oil mixture.
 - 2. Torque Requirements - Bolts shall be stressed to 45,000 psi.

Nominal Bolt Dia. (Inch)	Torque (Foot-Pounds)
0.25	6
0.3125	12
0.375	18
0.4375	30
0.5	45

0.5625	68
0.625	90
0.75	150
0.875	240
1.0	368
1.125	533
1.25	750
1.375	1020
1.5	1200

3. Torque shall be checked with a calibrated breaking action torque wrench on the final torque round. Bolts shall be cold and hot torqued.
4. Torque Pattern - Shall be a cross or star pattern with at least four passes. Limit each pass to 30% of full torque increases.
5. Hot Torque - Re-torque the flange bolts with system at normal operating pressure and temperature for at least four hours.
6. Inspection - Owner shall verify hot torquing of all medium and high pressure steam flange bolts.

PART 3 - EXECUTION

Refer to other Sections for service specific requirements.

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.
- J. Install valves with stems upright or horizontal, not inverted.

3.3 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.
- B. Slope water piping and arrange to drain at low points.

END OF SECTION 23 20 10

SECTION 23 21 00 – HYDRONIC PIPING

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 WORK INCLUDED
- A. Pipe and Pipe Fittings
 - B. Valves
 - C. Chilled Water Piping System
- 1.3 SCOPE OF WORK
- A. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with, or properly incidental to, the construction of complete HVAC piping and accessories systems as indicated on the Drawings, reasonably implied therefrom, or as specified herein unless specifically excluded.
- 1.4 RELATED WORK
- A. Section 08 31 13 - Access Doors
 - B. Section 09 91 00 - Painting
 - C. Section 23 20 10. - Piping, Valves and Fittings
 - D. Section 21 05 48. - Vibration Isolation
 - E. Section 23 07 19. - Piping Insulation
 - F. Section 23 06 20.13. - Hydronic Specialties
- 1.5 REFERENCES
- A. ANSI/ASME - Boiler and Pressure Vessel Code
 - B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications
 - C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300
 - D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV
 - E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
 - F. ANSI/ASME B31.9 - Building Services Piping
 - G. ANSI/AWS A5.8 - Brazing Filler Metal
 - H. ANSI/AWS D1.1 - Structural Welding Code
 - I. ASTM A135 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
 - J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - K. ASTM B32 - Solder Metal
 - L. ASTM B88 - Seamless Copper Water Tube
 - M. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

- N. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
- O. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

1.6 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9

1.7 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC. 9, and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/AWS D1.1.

1.8 SUBMITTALS

- A. Submit product data under provisions of Section 23 00 00.
- B. Include data on pipe materials, pipe fittings, valves, and accessories.
- C. Include welder's certification of compliance with ANSI/AWS D1.1.
- D. Contractor to provide cleaning and flushing plan consisting of the following:
 - 1. Markup of plans indicating which sections are to be flushed at a time, the location of flushing bypasses and pump connections, and the anticipated velocity at each section of pipe.
 - 2. Performance data on pump to be used for flushing

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 WALL, FLOOR AND CEILING PLATES:

- A. See Section 23 05 29.

2.2 SLEEVES, INSERTS, AND FASTENINGS:

- A. See Section 23 05 29.

2.3 CHILLED WATER PIPING - ABOVE GROUND:

- A. See Section 23 20 10 and 23 06 20.
 - 1. All piping shall be Standard Weight black steel pipe.
 - 2. All unions: Class 300.
 - 3. Low Zone (0' to 150' elevation)
 - a. Fittings on piping 2-1/2" and larger shall be standard weight butt welding type. Flanges shall be 150# welding neck type. Standard weight Weld-O-Lets, Thread-O-Lets, and shaped nipples may be used only when take-off is 1/3 or less nominal size of main. Bushings shall not be used.
 - b. Fittings on piping 2" and smaller shall be Class 150 black malleable iron screw fittings. (Class 300 for unions.)
 - c. Valves and strainers: Class 150.

2.4 EQUIPMENT DRAIN PIPING:

- A. All factory fabricated or field erected air conditioning units with drain pans, all centrifugal water pumps and all other items or equipment or apparatus that require drains shall be connected with drain line run with adequate slope to a floor drain or other point of discharge as shown on the Drawings. On A.C. units the drain line shall include a properly sized water-sealed trap.
- B. All drain piping shall be one inch (1") size minimum or larger as may be indicated on the Drawings. Such piping shall be Type L hard copper tube. The drain piping shall be assembled with adapter tees at each change in direction. Install screw plugs in unused openings for access to rod and clean.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 22 13 16.UT

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work.
- C. Group piping whenever practical at common elevations.
- D. Provide clearance for installation of insulation, and access to valves and fittings.
- E. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to weld area.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09 91 00.
- I. Install valves with stems upright or horizontal, not inverted.

3.3 FABRICATION OF PIPE:

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.
- F. Procedure for Assembling Other Joints: Procedures for assembling joints in cast iron and copper lines have been set forth elsewhere in these Specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install calibrated balancing valves for throttling, bypass, or manual flow control services.
- D. Use lug end butterfly valves to isolate equipment.
- E. Provide 3/4 inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.

3.5 PIPE PRESSURE TESTS:

- A. See Section 23 00 00

3.6 CLEANING AND FLUSHING OF WATER SYSTEMS

- A. Water circulating systems shall be thoroughly cleaned before placing in operation to rid systems of rust, dirt, piping compound, mill scale, oil, grease, any and all other material foreign to water being circulated.
- B. Extreme care shall be exercised during construction to prevent dirt and other foreign matter from entering the pipe or other parts of systems. Pipe stored on the project shall have open ends capped and equipment shall have openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and dirt removed.
- C. At pipe end locations a temporary bypass will be installed. Bypass shall be *same* size as the supply and return pipe. Prior to flushing the distribution system, the Contractor shall install the temporary bypass and a temporary line size strainer between the supply and return pipes. Contractor shall verify that the isolation valves are open.
- D. After the temporary bypasses are installed, the Contractor shall provide and operate one pump which will cause a velocity of 10 feet per second in the branch and main piping. This pump will be provided with a shot chemical feeder and a strainer assembly. If the pump is electric driven, rather than engine driven, the Contractor shall provide all temporary electrical disconnects, wiring, fuses, and other electrical devices that are required for safe operation. The Contractor shall provide temporary meters for all branch piping and one for main piping if a permanent flow meter is not specified.
- E. Circulation will be started using the temporary pump. A non-hazardous cleaning compound (Entec 324 or approved equal) shall be added using the shot feeder until the concentration level of 20 parts per million is reached. Once this 20 parts per million concentration is reached, circulation will be maintained for 48 hours. After this period of time, the cleaning water shall be dumped to the sanitary sewer.
- F. The bypass piping shall be removed and all piping reconnected to the equipment. The distribution system will then be refilled with city water and circulated with continual bleed and make-up until the water is certified clean by the water treatment consultant, and accepted by the Owner. At the completion of this step an inhibitor, compatible with the Campus utility line system, shall be introduced. All waste water shall be dumped into the sanitary sewer system.
- G. After the system is certified as clean, the Contractor shall close the valves. During the flushing procedure, strainers shall be cleaned as often as necessary to remove debris and, in any event, all strainers shall be cleaned by physically removing the strainer screen from the body of the strainer at the end of flushing. Replace strainer basket and gasket. Contractor shall not flush through control valves, coils, etc. Contractor shall provide temporary bypasses at coils and spool pieces at control valves. Flush the coils individually wasting water to sanitary sewer. Connect coils and install control valves after flushing.
- H. Test samples shall be taken at all bypass locations and all tests shall indicate that the entire system has reached a PH, conductivity, and chemical concentration level as approved by the Owner to match present systems. Contractor shall purchase needed chemicals from Owner's chemical treatment supplier.
- I. Contractor shall provide a smaller assembly to clean and flush any miscellaneous piping that cannot be included in the initial system flush. All other criteria shall remain the same.

- J. Contractor shall add inhibitor to the cleaning and flushing chemicals if, once the system is approved as clean, there is any delay in connecting the new system to the existing system. This is to prevent any corrosion after the new pipe is clean.

END OF SECTION 23 21 00

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SECTION 23 30 00 - UNDERFLOOR AIR DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install a complete access floor air distribution system as shown on the drawings, including all wiring, controls and other accessories required for a complete system. Contractor shall provide submittals, samples, and operation and maintenance documentation. Specific equipment includes:
 - 1. MIT3-CS, variable-air-volume diffuser terminal unit.
 - 2. TEC-2688/2647, space thermostats.
 - 3. PM, underfloor supply power module.
 - 4. PAP Plug and Play modular control wiring
- B. The Access Floor Contractor shall furnish and install all floor panels, structural supports, underfloor Airway barriers, floor cutout openings and any other floor-related components and accessories necessary for a complete raised access floor system.
- C. The General Contractor shall be responsible for sealing the access floor system and all penetrations through the building wall and floors that occur below the raised floor elevation.
- D. The TAB Contractor in conjunction with the General Contractor shall pressure test the raised floor plenum thermal zone at 0.05" W.G. with finished floor in place, all floor electrical/telecom/data boxes in place, and all air devices sealed. There shall be no more than 20% leakage, with a target leakage level of 10%.
- E. All openings in access floor panels required for installation of diffusers and terminals shall be coordinated with the Access Floor Contractor who shall also be responsible for providing the factory cut holes for diffusers (or cutting the panel openings only if such factory cutting is not available) and installing panels as indicated on the drawings.
- F. The Electrical Contractor shall furnish and install all electric power-related materials above 24vac and components necessary for system operation.
- G. The Controls Contractor shall furnish and install all control system interfaces, Building Automation System (BAS) integration, and other control system-related materials and accessories. The Controls Contractor shall install the factory furnished PAP wiring to the tstats and underfloor temperature controllers.
- H. Pricing for materials included in this section shall be submitted through a separate bid number, not to be included with other bids.

1.2 QUALITY ASSURANCE

- A. All equipment and components shall be suitable for use in an environmental Airway space.
- B. All components within the air stream including underfloor terminals shall conform to the NFPA 90A Standard for Flame/Smoke/Fire contribution of 25/50/0. Dampers, electrical enclosures, dust pans, and duct connecting plenums shall be metal. Plastic is not permitted for these components.
- C. All units shall be the product of a single manufacturer who is regularly engaged in the production of underfloor air distribution system.
- D. Units shall be specifically designed for installation in an underfloor air distribution system and shall be furnished complete with all necessary controls and wiring to provide operation according to manufacturer's recommendations.
- E. Terminal operation shall be coordinated with the air-handling system and control system to assure complete compatibility and proper operation.
- F. Equipment shall be listed under and conform to appropriate sections of U.L., CSA, E.T.L. and other testing laboratory requirements as required by local building codes.

1.3 SUBMITTALS

- A. Submit dimensioned drawings, performance and product data for approval. Include listing of discharge and radiated sound power level for the second, third, fourth, fifth and sixth octave bands for fan-powered terminal units. Data shall include all wiring diagrams, control sequences and power requirements as applicable to the product and coordination with other systems.
- B. Submit diffuser samples for approval.
- C. Submit certified independent 3rd party sound testing data on all diffusers and terminal units.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance and Service Contracts: Provide a list for each product and include the name, address and telephone number of:
 - 1. Subcontractor or installer.
 - 2. Local Maintenance Contractors, as appropriate. Identify responsibility of each.
 - 3. Local source of supply for parts and replacement.
- B. Table of Contents: List all products in the order in which they appear in the specifications and label accordingly.
- C. Sections: All sections shall be separated with an appropriate tabbed section divider with the appropriate specification section number. Provide the manufacturer's written installation and maintenance instructions for all items supplied.
- D. Routine Maintenance: Provide a list indicating all routine maintenance procedures and recommended intervals.
- E. Contents: Include copies of approved submittal data, installation instructions, operation and maintenance instructions and parts lists.

1.5 WARRANTY

- A. The underfloor Airway distribution system components, materials and workmanship shall be guaranteed to be free from defects for a period of one year after start-up or 18 months from date of shipment from the factory, whichever occurs first.
- B. Contractor and/or vendor shall maintain availability of replacement parts compatible with the terminals for no less than ten years after acceptance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide system by the following manufacturer:
 - 1. JCI Flexsys

2.2 GENERAL DESCRIPTION

- A. The Contractor shall furnish a pre-engineered, prefabricated, access floor air terminal system that includes all necessary components from a single manufacturer. All components, including controls and wiring, shall be furnished as a "plug-and-play" system of modular and interchangeable components that are factory prepared to operate as a complete system.
- B. Supply Terminals
 - 1. Construction of unit shall permit easy cleaning and prevent dirt and debris from entering system; and no plastic dampers, grilles or other parts shall be exposed to the Airway space or air stream whether or not in accordance with NFPA 90A.

2. Variable air volume diffuser terminal Unit shall include a chassis. The chassis shall be minimum 20-gauge galvanized steel pre painted flat black and shall enclose and support all components. Chassis construction shall admit underfloor air from only one direction to control sound transmission. Airflow volume control shall be pressure independent with airflow sensor and controller or time modulation control.
3. Supply air terminals shall have grilles made of die cast aluminum material that matches the trim ring in color. Grilles shall include a means for adjusting air throw direction and pattern, and shall fit securely within the trim ring and chassis without mechanical fasteners. Grilles shall be rated for 1,250 pounds. No grille openings shall be larger than 0.30 inches (7.6 mm) for shoe heel penetration protection.
4. Grille trim rings shall be die-cast aluminum designed to engage the chassis and floor to provide complete support for the air grilles. Trim ring color shall match the grille color. Plastic or any Non-Metallic diffusers are not acceptable.
5. Panel Size: Unless noted otherwise, the nominal dimensions of all floor-mounted system components shall be suitable for installation in a standard 24-inch by 24-inch (610-mm by 610-mm) raised access floor suspension grid.
6. Airflow Performance: The manufacturer shall provide published airflow data for the all supply and return terminals in accordance with ANSI/ASHRAE Standard 70-1991.
7. Variable-Air-Volume Controls: Terminals specified for variable-air-volume service shall incorporate the following requirements:
 - a. Terminal construction shall include an integral time-modulation damper and motor (air valve) that is specifically designed for low static pressure air distribution to maintain a constant throw height and distance at all load conditions. The damper motor shall be a 90-degree stepper type motor having no stops, springs, gears, belts or linkages, and shall rotate continuously in one direction (not reversing) to minimize wear. The motor shall directly drive the damper blade. The damper assembly shall be rated and tested for a life of 100 million cycles (factory tests of at least 20 million cycles at normal operating speeds are required). A warranty of up to 10 years shall be available at a cost of 1% of the cost of the VAV box cost, per year of extended warranty. Modulation shall involve the timed duty cycle of fully open and closed periods to produce an average open time corresponding to the average terminal air volume required. If this time modulation strategy is not used, (2) VAV diffusers of ½ size (of the scheduled cfm per diffuser) shall be provided and installed, for each diffuser shown on the plans. The first diffuser will modulate 100% to 0 while the second will remain at 100%. When the load falls below 50%, the first diffuser shall shut off completely and the second shall modulate from 100% to a field adjustable minimum cfm via pressure independent control with airflow sensor and controller. This strategy will prevent pooling of cold air at floor levels and insure delivery of conditioned air to the breathing zone (up to 6 ft) at all load conditions. If the 2 for 1 diffuser strategy of control is employed, the mechanical contractor will be responsible to coordinate with all other trades including but not limited to carpenters, electricians, raised floor installer, carpet installer and controls contractor.
 - b. Terminal shall include a microprocessor control that controls the damper movement in response to a remote digital signal. The digital signals and power shall be delivered to the device through a 4-conductor, plenum-rated modular cable furnished with the terminal. A “daisy-chain” output port shall be furnished that repeats the digital signals with a nominal 6 second delay, and provides parallel connection of the 24 volts ac control power supply to other connected terminals. This 6 second delay prevents all the air terminals in a zone from actuating at the same time.
 - c. The damper and motor shall be designed for continuous use with a nominal design life of 100,000,000 cycles. The installed damper and motor operation shall be inaudible with a background sound level of 30 dbA and shall be tested to be quieter than NC-17 with full airflow. The unit shall feature all solid-state electronics, self-contained within a housing using printed circuit board mounted components with no relays, mechanical switches, or other analog devices required for operation of the device.
 - d. The terminal shall not require periodic lubrication or other maintenance. The device shall be delivered to the job site fully assembled and operational, needing no programming, setup or adjustment.

8. MIT-CR Type-C; VAV Diffusers
 - a. Type-C Grille: nominal 10 inch diameter.
 - b. Type-C Supply Rating: variable-air-volume, 130 cfm at 0.05 inches w.g. static pressure.
 - c. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.
 - d.
9. Space Thermostat: Provide wall mounted thermostat device for seamlessly controlling FlexSys underfloor vav terminal diffuser units and underfloor fan terminal units. Thermostat shall include the following features:
 - a. Building Automation System (BAS) BACnet MS/TP communication capability that enables remote monitoring and programmability for efficient space temperature control. Thermostat shall be compatible with other BACnet device, or BACnet network or BACnet BAS. RS-485 twisted pair shall be field provided by control Contractor for networking to BACnet.
 - b. Thermostat shall include user interface with backlit temperature display in Degree F temperature.
 - c. Factory pre-wired plug and play pigtail. Include (1) 10 foot PAP-7 for connection to FlexSys terminal units.
 - d. Set points shall be permanently held in memory with no batteries used. Retain setpoint during power outages.
 - e. Thermostat shall be rated for 24 VAC operation with plug and play cabling.
 - f. Thermostat shall employ a unique, Proportional-Integral (PI) time-proportioning algorithm that eliminates temperature offset associated with traditional, differential-based thermostats.
 - g. Thermostat model 2688, DDC space thermostat shall be used for cooling only time-modulation control.
 - h. Thermostat model 2647, DDC space thermostat shall be used for underfloor fan terminal unit signal control in cooling and in heating, or to control modulating PM, Power Module
 - i. Input power: 120 volts ac, single-phase, 60 Hertz.
 - j. Transformer Output Rating: 90 volt-ampere class 1 transformer, 24 volts ac, with load side circuit breaker.
 - k. Output connection: Molex modular "plug-and-play" connector with 25'-0" PAP-5 power cable.
 - l. Housing: steel junction box with knockouts for conduit.
10. Modular Control System Cables
 - a. Modular control cables shall be rated for plenum service and shall be equipped (unless indicated otherwise) with Molex modular plug-and-play electrical connectors with strain relief at connectors. RJ-11 cables are not acceptable. Each Cable shall be factory-tested for continuity, shorts, opens and proper impedance. Each cable shall bear evidence tag of QC testing. Plug and play cables shall be color coded as follows to distinguish them from other communication cabled used under floor. The specific colors below must be used.
 - 1) PAP-1, General purpose cable: 4-conductor, 18-gauge, and 25 feet (7.6 m) long, with Molex modular receptacle at both ends. Identification color: blue.
 - 2) PAP-2, External device (whip) cable: 4 conductor, 18 gauge, 50 feet (15.2 m) long, with Molex modular receptacle on one end and pig tail on the other. Identification color: yellow.
 - 3) PAP-3, Extension cable: 4-conductor, 18-gauge, 25 feet (7.6 m) long, with Molex modular receptacle on one end and plug on the other end. Identification color: blue.
 - 4) PAP-5, Power only cable: 2-conductor, 18-gauge, and 25 feet (7.6 m) long, with receptacles at both ends. One end shall have an additional short 4 conductor jumper with a plug to permit daisy-chaining one power distribution cable to another. For 24 volts ac, single-phase, 60 hertz power only. Identification color: green.

- 5) PAP-6, Heating cable: 2 conductor, 22-gauge, 50 feet (15.2 m) long, with receptacle at one end and both receptacle and plug on the other end. Identification color: orange.
- 6) PAP-7, Thermostat cable: 8 conductor, 18-gauge shielded, 10 feet (9.1 m) long, with 2 plugs on one end, and 2 receptacles on the other end. Identification color: white.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prior to installing underfloor Airway distribution components, verify that all penetrations and openings in the area under the raised access floor have been sealed.
- B. Verify that the building area under the raised access floor has been cleaned and is free of dust, dirt, debris, standing water and other contaminants.
- C. Install all underfloor air distribution system components, including supply air terminals, fan-powered terminals and controls in accordance with the manufacturer's instructions.
- D. Prior to installation, all components shall be stored in a clean, dry location that is protected from weather and damage from other construction activities.
- E. Coordinate installation of underfloor Airway distribution components with the Access Floor Contractor, who is responsible for erection of the raised access floor.
- F. Coordinate location and size of all cut openings in raised access floor panels with the Access Floor Contractor.
- G. Install supply air terminals, fan-powered terminals and other components in the locations indicated on the drawings.
- H. All power and control wiring shall be installed in accordance with the requirements of Division 26 Specifications.
- I. All power and control wiring for the underfloor Airway distribution system components shall be installed in a neat and workmanlike manner.
- J. Line voltage and sensor wiring shall not be installed in the same harness.
- K. Low voltage and communication wiring (less than 30 volts) may be installed in the same wiring harness.

3.2 TESTING

- A. Upon completion of all installation activities, perform the manufacturer's pre-start checkout instructions.
- B. Start-up and operate underfloor Airway distribution system components to demonstrate functional operation and compliance with specifications.

END OF SECTION 23 30 00

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SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 WORK INCLUDED
- A. Low Pressure Ducts
 - B. Medium and High Pressure Ductwork
 - C. Duct Cleaning
- 1.3 RELATED WORK
- A. Division 09 Section, Painting, priming or coating of metal ductwork exposed to view.
 - B. Section 23 05 48 - Vibration Isolation
 - C. Section 23 07 13 - Duct Insulation
 - D. Section 23 33 00 - Ductwork Accessories
 - E. Section 23 37 00 - Air Inlets and Outlets
 - F. Section 23 05 93 - Testing, Adjusting and Balancing
- 1.4 REFERENCES
- A. ASHRAE - Handbook of Fundamentals; Duct Design
 - B. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction
 - C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
 - D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
 - G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate
 - H. NFPA 45 – Laboratory Ventilating Systems and Hood Requirements
 - I. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 - J. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
 - K. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment
 - L. SMACNA – HVAC Duct Construction Standards, 1995
 - M. UL 181 - Factory-Made Air Ducts and Connectors
 - N. SMACNA Round Industrial Duct Construction Standards,.
 - O. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).
 - P. Assembly and Installation of Spiral Duct and Fittings, IMC.
 - Q. Engineering Report No. 132 (Spacing of Duct Hangers), IMC.

- R. AWSD1.1 American Welding Society Structural Welding Code

1.5 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: 3 inch WG positive or negative static pressure and velocities less than 1,500 fpm.
- C. Medium Pressure: 6 inch WG positive static pressure and velocities greater than 1,500 fpm.
- D. High Pressure: 10 inch WG positive static pressure and velocities greater than 2,500 fpm.

1.6 SUBMITTALS

- A. Product Data
 - 1. Provide product data for all ductwork systems to be used on project. Product data submittals shall include the following as a minimum:
 - a. System name and type
 - b. Duct system design pressure
 - c. Hangers and supports, including materials, fabrication, methods for duct and building attachment.
 - d. Sealant type.
 - B. Shop Drawings shall be submitted on all items of sheet metal work specified herein. Shop Drawings of ductwork at air units shall be submitted at a minimum scale of 3/8" equal to one foot. Shop drawings of ductwork located at all other locations shall be prepared at a scale of not less than 1/4" = 1'-0". Reproduction and submittal of the construction documents is not acceptable. Shop drawings shall include the following:
 - 1. Clearance dimensions between ducts and dimensions above finished floors for bottom and tops of ducts.
 - 2. Call out of duct materials other than galvanized including but not limited to stainless steel, aluminum, or prefabricated fire rated ductwork.
 - 3. Shop Drawings shall indicate location of all supply, return, exhaust and light fixtures from the approved reflected ceiling plans.
 - 4. Shop drawings shall identify all duct sizes, reinforcement and spacing.
 - 5. Penetrations through fire rated and other partitions.
 - 6. Show major equipment with ductwork connections.
 - C. Show all dampers, turning vanes, access doors, fire dampers and all other ductwork accessories to be provided. Submit shop drawings and product data under provisions of Section 23 00 00.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 23 00 00.
- B. Store and protect products under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.1 DUCTWORK GENERAL:

- A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA Duct Manuals where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein. All exhaust ductwork including toilet room exhausts shall be constructed and leak tested as specified for medium pressure supply ducts at negative pressure.

- B. All ductwork shown on the Drawings, specified or required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner. The work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Architect.
- C. All duct sizes shown on the Drawings are air stream sizes. Allowance shall be made for internal lining where required, to provide the required cross sectional area.
- D. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time.
- E. Except for special ducts specified elsewhere herein, all sheet metal used on the project shall be constructed from prime galvanized steel sheets and/or coils up to 60" in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on ten foot (10') centers with manufacturer's name and must be visible after duct is installed. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."
- F. Where ducts that are exposed to view (including equipment rooms), pass through walls, floors or ceilings, furnish and install sheet metal collars around the duct.
- G. Ductwork taps shall be made using bellmouth or "boot" connections, and they shall be from the side of the duct, not the bottom unless there is at least 24" clear from the bottom of the duct to the outlet. This will allow for a better location for the volume dampers. No more than 3 rooms of similar size, orientation, and function should be on the same zone. Directors' offices, conference rooms, and other special purpose rooms should be on an individual zone. Note that a small corridor area or storeroom may be added to almost any small zone. Zones requiring large amounts of air (such as auditoriums or laboratories) may require more than one VAV box.

2.2 DUCTWORK LOW PRESSURE: (INCLUDES ALL EXHAUST DUCTWORK DOWNSTREAM OF FANS.)

- A. The scope of low pressure ductwork is defined as all ductwork downstream of terminal units, and all exhaust ductwork downstream of fans. Construction of all low pressure duct shall be in accordance with Low Velocity Duct Construction Standards as published by Sheet Metal and Air Conditioning Contractors National Association (SMACNA) and shall be sealed and tested at 3" static with the same test procedures as medium pressure ductwork.
- B. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
- C. The metal gauges listed in the 1995 SMACNA HVAC Duct Construction Standards for Metal and Flexible Duct are the minimum which shall be used for this project. It shall be noted that the Contractor is responsible that the metal gauge selected is heavy enough to withstand the physical abuse of the installation.
- D. Elbows shall be radius type and have a centerline radius of 1-1/2 times the duct diameter or width. Elbows in round ducts may be smooth radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows. Joints in round ducts shall be slip type with a minimum of three sheet metal screws. Joints in sectional elbows shall be sealed as specified for duct sealing. 90° mitered elbows are not acceptable unless approved by the Architect/Engineer or Project Manager.

- E. SEALANT: All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", Polymer Adhesive "Airseal #11", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. For exterior applications, "Uni-Thane " (United McGill Corp.) polyurethane based sealant shall be used. No other sealants may be used. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. All sealants shall be UL rated at no more than flame spread of 5 and smoke developed of 0. At contractor's option, Hardcast 1602 sealant tape may be used in lap joints and flat seams.
- 2.3 DUCTWORK MEDIUM PRESSURE: (INCLUDES ALL EXHAUST DUCTWORK UPSTREAM OF FANS).
- A. The scope of medium pressure ductwork is defined as all ductwork downstream of all air handlers, up to and including terminal units, plus all return air ductwork. Construction of all ducts shall be in accordance with High Velocity Construction Standards as published by SMACNA. All round and rectangular duct construction, duct fittings, dampers, etc., are covered in this manual and it is to be adhered to.
1. Spiral wound round duct shall be as manufactured by United McGill Sheet Metal Company or approved equal.
 2. The metal gauges are listed herein for round duct and for rectangular duct.
- B. All ductwork (except welded exhaust duct) shall be sealed with either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", or "United Duct Seal" (United McGill Corp.) water base, latex or acrylic type sealant. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. For exterior applications, "Uni-Thane" (United McGill Corp.) polyurethane based sealant shall be used. No other sealants may be used. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. At contractor's option Hardcast 1602 sealant tape may be used in lap joints and flat seams.
- C. Oval ducts shall be spiral flat oval or welded flat oval equal to those of United McGill Sheet Metal Company with gauges and reinforcing as recommended by the manufacturer for medium pressure or the ducts may be Shop fabricated of completely welded construction of the following gauge:
1. Major Axis 12 to 20 No. 24 gauge
 2. Major Axis 20 to 30 No. 22 gauge
 3. Major Axis 30 to 46 No. 20 gauge
 4. Major Axis 46 to 50 No. 18 gauge
 5. Major Axis 50 and Up No. 16 gauge
- D. Oval fittings shall be equal to those of United McGill Sheet Metal Company with requirements, sealing, etc., similar to that specified for round medium pressure work.
- E. Oval duct reinforcing methods shall be submitted as Shop Drawings for approval. Reinforcing galvanized angles shall be of sizes specified for same size rectangular ducts. Galvanized angles shall be used where standing seams are specified for rectangular ducts. Attaching methods shall be shown on Shop Drawings and submitted for approval.
- F. Testing of Medium Pressure Ductwork: (Includes from fan discharge through to the discharge of terminal units.)
1. All medium pressure ducts shall be pressure tested according to SMACNA Chapter 10 test procedures. Design pressure for testing ductwork shall be six inches (6") of water. Total allowable leakage shall not exceed 1% of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all Sections shall not exceed the total allowable leakage.

2. The entire system of medium pressure ductwork shall be tested, including the VAV/Constant Volume Terminal Units (i.e. The ductwork shall be capped immediately prior to the Terminal Units, and tested as described above). After testing has proven that the ductwork is installed and performs as specified, the terminal units shall be connected to the ductwork and the connections sealed with extra care. The contractor shall inform the project inspector when the joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage in the terminal unit connections/joints after the systems have been put into service, the leaks shall be repaired by: 1) complete removal of the sealing materials, 2) thorough cleaning of the joint surfaces, and 3) installation of multiple layers of sealing materials.
3. At the option of the Owner, the Contractor may be allowed to eliminate the terminal units from testing by capping the supply ductwork prior to the terminal units, then inspecting the connection to the terminal units when complete. This option may only be exercised by the Resident Construction Manager, and then only if documented in writing prior to testing.

- G. All exhaust ductwork, including toilet room exhausts, shall be constructed as for medium pressure ducts and shall be tested for leaks in the same manner as for medium pressure supply ducts.
- H. Contractor may use DUCTMATE or Ward flanged Duct Joint system, reference SMCNA FIG. 1-4 "Transverse Joints" T-25a or T-25b on rectangular ductwork. Slip-on duct flanges are not acceptable. Contractor may at his option (where space permits) use rectangular ductwork with DUCTMATE or Ward system in lieu of oval ductwork.
- I. Rectangular 90 degree elbows shall be constructed with single thickness turning vanes mounted on an integral rail. Mitered 90 degree elbows are not allowed unless approved by the Engineer and Construction Manager. Radius type rectangular elbows shall have a centerline radius of 1-1/2 times the duct diameter or width. . Elbows in round or oval ducts may be smooth long radius as described above or 5-piece 90 degree elbows and 3-piece 45 degree elbows. Joints in round ducts shall be slip type with a minimum of three sheet metal screws. Joints in sectional elbows shall be sealed as specified for duct sealing.

2.4 MIXED AND R. A. (LOW PRESSURE) CASING PLENUMS:

- A. All low pressure casings and plenums shall be following gauges and construction:

<u>Casing Height</u>	<u>Galv</u>	<u>Alum.</u>	<u>Angles</u>	<u>Standing Seams</u>
Up to 4'	20 ga.	.051	1 x 1 x 1/8"	1"
4' to 6'	18 ga.	.051	1 x 1 x 1/8"	1"
6' to 8'	18 ga.	.064	1-1/2 x 1-1/2 x 3/16"	1-1/2"
8' to 10'	18 ga.	.064	1-1/2 x 1-1/2 x 3/16"	1-1/2"
Over 10'	16 ga.	.064	2 x 2 x 3/16"	1-1/2"

- B. All low pressure casings shall be fabricated by the Mechanical Contractor enclosing the filter and automatic dampers as shown on the Drawings. The casing shall be fabricated of galvanized sheet metal erected with 3 foot center maximum standing seams reinforced with 1/4 inch bars. The casing shall be stiffened on three foot centers maximum with angle irons tack welded in place.
- C. All openings to the casing shall be properly sealed to prevent any air leakage. Access doors shall be installed as shown and shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches and #370 hinges that can be operated from both the inside and the outside.
- D. Casings shall be anchored by the use of angle irons sealed and bolted to the curb and floor of the apparatus casing. Submit Shop Drawings for approval. The casing shall be tested and provided tight at a pressure of three inches water column.
- E. The casing shall have 1" thick duct liner applied as specified under paragraph "Duct Liner" in this section.

2.5 ELBOWS:

- A. Where rectangular elbows are shown, or are required for good air flow, contractor shall provide and install turning vanes. Turning vanes shall be factory fabricated with integral support rail. Radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Submit Shop Drawings on factory fabricated and job fabricated turning vanes. Provide turning vanes in all rectangular radius elbows and offsets.
- B. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks.

2.6 FLEXIBLE DUCTS:

- A. Low Pressure Insulated Flexible Duct may be used where shown on the drawings. Duct shall be made with factory preinsulated duct supported by a corrosion resistant metal spiral, or a coated spring steel helix and solid inner liner mechanically interlocked or permanently bonded to the helix wire, covered with a minimum of 1-1/2" thick, 3/4 lb. density fiberglass blanket sheathed in a vapor barrier of fiberglass reinforced aluminum foil and Mylar laminate. The insulation shall have a minimum "K" factor of 0.29 at 60 degrees F. mean and a vapor barrier permeability rating of 0.05 per ASTM method E96-66, Procedure A. The C factor shall be 0.24 to meet HUD requirements. The duct shall be rated for a positive working pressure of 10" w.g. and a temperature of up to 250 degrees F. The duct shall comply with NFPA 90A and be listed and labeled by Underwriters Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread, not over 25; smoke developed, not over 50. Flexible ducts shall be not more than 5'-0" in length, shall be installed as indicated in the diffuser connection detail, and shall be Flexmaster Type 1M or approved equal.
 - 1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp equal to Ideal Series 56 Snaplock. The fittings on Air Devices and on sheet metal duct shall be coated with the sealant specified for low pressure ductwork, then flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with more sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts mixing box or insulation on duct. These insulation connections shall be sealed by imbedding fiberglass tape in the sealant specified for medium pressure ductwork and coating with more sealant to provide a vapor barrier. (This applies to all flex connections to diffusers, grilles, etc. when allowed on the drawings.)
 - 2. Medium and High Pressure Insulated Flexible Duct shall be factory applied insulation of 1" minimum thickness, 3/4 lb. density with a permeability rating of 0.30. The duct shall be composed of dead soft, spiral wound, triple locked corrugated aluminum core covered with Ratings shall be as described for Low Pressure Duct above. Flexible ducts shall be not more than 2'-0" in length, used for alignment or sound/vibration purposes only, and may only be installed in straight runs. Flexible duct shall NOT be used for changes of direction of air flow, and shall be Flexmaster Type TL-M or approved equal. Installation, clamps and sealing shall be the same as specified for rigid duct.

2.7 DUCT LINER:

- A. Where indicated on the Drawings, ducts shall have lining equal to Fiberglass Aeroflex No. 150 duct liner. Duct liner shall be one inch (1") thick unless otherwise indicated. The liner shall be applied to the inside of the duct with heavy density side to the air stream and shall be secured in the duct with fireproof 3M #37 or St. Clair R41B adhesive, completely coating the clean sheet metal. All joints in the insulation shall be "buttered" and firmly butted tightly to the adjoining liner using fireproof adhesive. Where a cut is made for duct taps, etc., the raw edge shall be accurately and evenly cut and shall be thoroughly coated with fireproof adhesive. On ducts over twenty-four (24") in width or depth, the liner shall be further secured with mechanical fasteners. The fasteners shall be A. J. Gerrard Company pronged straps, or approved equal, secured to the ducts by fireproof adhesive. The clips shall be eighteen inch (18") maximum spacing and shall be pointed up with fireproof adhesive. Liner shall be accurately cut and ends thoroughly coated with fireproof adhesive so that when the duct section is installed, the liner shall make a firmly butted and tightly sealed joint. Where ducts are lined exterior insulation will not be needed unless otherwise noted, except that the two insulations shall not lap less than twenty-four inches

(24"). Dimensions given on the Drawings are metal sizes. Refer to Section 23 00 00 for Flame-Spread Properties.

- B. Duct liner in medium pressure ducts shall be the same except a perforated metal liner shall be used over duct liner for securement in lieu of fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer also to requirements included in Part 2 of this specification.
- B. Obtain manufacturer's inspection and acceptance of fabrication and installation of fiberglass ductwork prior to beginning of installation.
- C. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Connect terminal units to medium or high pressure ducts directly or with two feet maximum length of flexible duct. Do not use flexible duct to change direction. Allow for a minimum of 3 diameters of straight duct to the entrance of all terminal units.
- F. Connect diffusers with 5'-0" maximum length or troffer boots with 2' maximum length of flexible duct to low pressure ducts. Hold in place with strap or clamp, and seal as specified.
- G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 LOW PRESSURE DUCT SUPPORTS:

- A. See Section 23 05 29.

3.3 MEDIUM PRESSURE DUCT SUPPORTS:

- A. See Section 23 05 29.

3.4 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Medium Pressure Supply	Galvanized Steel
Low Pressure Supply	Galvanized Steel
Return/Relief Air	Galvanized Steel
General Exhaust Air	Galvanized Steel

3.5 CLEANING OF SYSTEMS:

- A. Before turning the installation over to the Owner, all ducts should be cleaned and blown free of all dust and dirt that has collected in the ducts.

END OF SECTION 23 31 00

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SECTION 23 33 00 – DUCTWORK ACCESSORIES

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
- A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 WORK INCLUDED
- A. Manual and Automatic Volume Control Dampers
 - B. Backdraft Dampers
 - C. Air Turning Devices
 - D. Flexible Duct Connections
 - E. Duct Access Doors
 - F. Duct Test Openings
- 1.3 RELATED WORK
- A. Products installed, but not furnished under this section include airflow stations and automatic control dampers to be provided by Controls Contractor under section 23 29 23.
 - B. Section 23 05 48 - Vibration Isolation
 - C. Section 23 31 00 - Ductwork
 - D. Section 23 36 00 - Air Terminal Units: Medium and High Pressure Damper Assemblies
- 1.4 REFERENCES
- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 - B. SMACNA - Low Pressure Duct Construction Standards
 - C. UL 33 - Heat Responsive Links for Fire Protection Service
 - D. UL 555 - Fire Dampers and Ceiling Dampers
- 1.5 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 23 00 00.
 - B. Provide shop drawings for shop fabricated assemblies indicated, including manual volume dampers, automatic control dampers, duct access doors, and duct test holes. Provide product data for hardware used.
 - C. Submit manufacturer's installation instructions under provisions of Section 23 00 00 for fire dampers and combination fire and smoke dampers.

PART 2 - PRODUCTS

2.1 DAMPERS

- A. Furnish and install manual volume dampers where shown on the drawings and wherever necessary for complete control of the air flow, including all supply, return and exhaust branches, "division" in main supply, return and exhaust ducts, each individual air supply outlet and fresh air ducts. Where access to dampers through a fixed suspended ceiling is necessary, the Contractor shall be responsible for the proper location of the access doors.
- B. Dampers shall be carefully fitted, and shall be controlled by locking quadrants equal to Ventlok No. 555 on exposed uninsulated ductwork, No. 644 on exposed externally insulated ductwork and No. 677 (2 5/8" diameter) chromium plated cover plate for concealed ductwork not above lay in accessible ceilings. Furnish and install end bearings for the damper rods on the end opposite the quadrant when No. 555 or No. 644 regulators are used, and on both ends when No. 677 regulators are used.
- C. On concealed ductwork above lay in accessible ceilings use Ventlok No. 555 or No. 644 locking quadrant for splitter dampers.
- D. Dampers larger than three (3) square feet in area shall be controlled by means of rods hinged near the leading edge of the damper with provisions for firmly anchoring the rod and with end bearings supporting the axle.
- E. Manual volume dampers shall be equal to Ruskin model CD60, Greenheck model VCD-33, or approved equal. Blades shall not exceed 48 inches (48") in length or twelve inches (12") in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16-gauge galvanized steel supported on one-half inch (1/2") diameter rust proofed axles. Axle bearings shall be the self-lubricating ferrule type.
- F. Install all automatic control dampers, furnished by the Temperature Control Manufacturer, in strict accordance with the manufacturer's recommendations and requirements of these Specifications.
- G. All adjustable dampers installed in externally insulated ductwork shall be installed with Ventlok No. 639, or equal, elevated dial operators. Insulation shall extend under the elevated dial. All adjustable dampers installed in internally insulated ductwork shall be installed with Ventlok No. 635, or equal, dial operators. All damper shaft penetrations in the ductwork shall be installed with Ventlok #609 end bearings.

2.2 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans, including roof exhausters, flexible connections shall be made using Ventglas fabric that is fire resistant, waterproof, mildew resistant and practically air tight, and shall weigh approximately thirty ounces (30 oz.) per square yard. There shall be a minimum of one half inch (1/2") slack in the connections, and a minimum of two and one half inches (2 1/2") distance between the edges of the ducts except that there shall also be a minimum of one inch (1") of slack for each inch of static pressure on the fan system. This does not apply to Air Handling Units with internal isolation.

2.3 ACCESS DOORS

- A. Furnish and install in the ductwork, hinged rectangular or round spin in access doors to provide access to all fire dampers mixed air plenums, upstream of steam reheat coils, automatic dampers, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. Where the size of the duct permits, the doors shall be eighteen inches (18") by sixteen inches (16"), or eighteen inches in diameter, and shall be provided with Ventlok No. 260 latches (latches are not required in round doors). Latches for rectangular doors smaller than 18" x 16" shall be Ventlok No. 100 or 140. Doors for zone heating coils shall be Ventlok, stamped, insulated access doors, minimum 10" x 12", complete with latch and two (2) hinges, or twelve inches (12") in diameter. Round access doors shall be "Inspector Series" spin in type door as manufactured by Flexmaster USA, or approved equal. Doors for personnel access to ductwork shall be nominal twenty four inches (24") in diameter.
- B. Where these access doors are above a suspended ceiling, this Contractor shall be responsible for the proper location of the ceiling access doors.

2.4 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor that lead to, or are, outdoors. Screens shall be No. 16-gauge, one half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.5 TEST OPENINGS

- A. Furnish and install in the return air duct and in the discharge duct of each fan unit Ventlok No. 699 instrument test holes. The test holes shall be installed in locations as required to measure pressure drops across each item in the system, e.g., O.A. louvers, filters, fans, coils, intermediate points in duct runs, etc.

2.6 DUCT TAPS (CONICAL FITTINGS)

- A. Conical fittings shall be used for duct taps and shall include quadrant dampers on all lines to air devices (diffusers and grilles), even though a volume damper is specified for the air device. A damper is not required for medium pressure duct taps. Spin in fittings shall be sealed at the duct tap with a gasket, or compression fit, or sealed with sealant specified for medium pressure ductwork. The location of spin in fittings in the ducts shall be determined after dual or single duct terminal units are hung or the location of the light fixtures is known to minimize flexible duct lengths and sharp bends.
- B. The conical fitting shall be made of at least 26-gauge galvanized sheet metal. The construction to be a two-piece fitting with a minimum overall length of 6 inches and shall be factory sealed for high pressure requirements. Average loss coefficient for sizes 6, 8, and 10 shall be less than 0.055.
- C. Each fitting shall be provided with a minimum 24-gauge damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper from rotating around shaft.
- D. Provide flange and gasket with adhesive peel-back paper for ease of application. The fitting shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on-center with a minimum of four screws per fitting.
- E. The conical bellmouth fitting shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc., or Buckley Air Products, Inc., 'AIR-TITE'.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide balancing dampers on medium or high pressure systems where indicated.
- D. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
- F. Provide duct access doors for inspection and cleaning before and after duct mounted filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated.
- G. Provide duct test holes where indicated and where required for testing and balancing purposes.

END OF SECTION 23 33 00

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SECTION 23 37 00 – AIR INLETS AND OUTLETS

PART 1 - GENERAL

- 1.1 THE FOLLOWING SECTIONS ARE TO BE INCLUDED AS IF WRITTEN HEREIN:
 - A. Section 23 00 00 – Basic Mechanical Requirements
 - B. Section 23 05 29 – Sleeves, Flashings, Supports and Anchors
 - C. Section 23 05 53 – Mechanical Identification
- 1.2 WORK INCLUDED
 - A. Diffusers
 - B. Diffuser Boots
 - C. Registers/Grilles
- 1.3 RELATED SECTIONS
 - A. Section 09 91 00 - Painting: Painting of Ductwork Visible behind Outlets and Inlets
 - B. Section 23 31 00 - Ductwork
 - C. Section 23 33 00 - Ductwork Accessories
- 1.4 REFERENCES
 - A. AMCA 500 – Laboratory Methods of Testing Louvers, Dampers and Shutters
 - B. ANSI/NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
 - C. ANSI/AHRI 881 - Performance Rating of Air Terminals
 - D. ANSI/AHRI 885 - Air Terminals
 - E. SMACNA - Low Pressure Duct Construction Standard.
- 1.5 QUALITY ASSURANCE
 - A. Test and rate performance of air outlets and inlets in accordance with ANSI/AHRI 881 and ANSI/AHRI 885.
- 1.6 REGULATORY REQUIREMENTS
 - A. Conform to ANSI/NFPA 90A.
- 1.7 SUBMITTALS
 - A. Submit product data under provisions of Section 23 00 00.
 - B. Provide product data for items required for this project.
 - C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
 - D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
 - E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.1 AIR SUPPLIES AND RETURNS:

- A. Grilles, registers and ceiling outlets shall be as scheduled on the Drawings and shall be provided with sponge rubber or soft felt gaskets. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will be not more than 50 FPM nor less than 25 FPM. Noise levels shall not exceed those published in the ASHRAE Guide for the type of space being served (NC level). Grilles, registers and ceiling outlets shall be Titus, Metalaire, Price, or approved equal.
- B. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual damper. These shall be the standard product of the manufacturer, subject to review by the Architect, and equal to brand scheduled.

2.2 EXHAUST AND RETURN REGISTERS/GRILLES

- A. Grilles shall have fixed deflection blades and shall be of the sizes and mounting types scheduled.
- B. Frames shall have 1 ¼" wide border on all sides. Screw holes on frames shall be countersunk so that screw heads sit flush with frame face.
- C. Fabricate of aluminum extrusions with factory acrylic paint finish.
- D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Section 09 91 00.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 00.

END OF SECTION 23 37 00

SECTION 23 37 16 - FABRIC DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Non-metal ductwork as indicated on drawings and by requirements of this section.
- B. Required type of non-metal ductwork for this project is a: Fabric Air Dispersion System.

1.2 QUALITY ASSURANCE AND CODE COMPLIANCE

- A. Quality Assurance:
 - 1. Manufacturer must be a UL Registered Firm.
 - 2. Any production facility used by manufacturer must be Registered by Underwriters Laboratories Inc. to the International Organization for Standardization (ISO) 9000 Series Standards
 - 3. Fabrics used must be produced in environmental friendly factories only. The actual production site for each individual fabric must be Oeko-Tex certified by Oeko-Tex International – Association for the Assessment of Environmental Friendly Textiles.
- B. Codes and Standards:
 - 1. Product must be classified in accordance with the 25/50 flame spread/smoke development requirements of UL723 based on NFPA 90A - 1993, "Installation of Air Conditioning and Ventilating Systems".
 - 2. Product must be treated with an EPA approved and listed antimicrobial agent

1.3 SUBMITTALS

- A. Submit a copy of UL Registered Firm certificate.
- B. Submit documentation for UL723 in accordance to NFPA-90A
- C. Submit documentation for EPA registration
- D. Submit manufacturer's drawings indicating size and placement of dispersion units, and mounting instructions.
- E. Submit manufacturer's technical product data for fabric dispersion units.
- F. Submit manufacturer's performance data for each fabric duct system, including airflow rate, inlet velocity, static pressure and exit velocity out of duct system.
- G. Submit manufacturer's maintenance data

1.4 WARRANTY

- A. Manufacturer must provide a 10 Year Non-Prorated Warranty. Prorated warranties are not accepted.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect fabric ductwork systems from damage during shipping, storage and handling.
- B. Store products inside and protect from weather.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer must comply with all previous described requirements. Approved manufacturers:
 - 1. FabricAir, Inc.
 - 2. Ductsox, Inc

2.2 FABRIC AIR DISPERSION SYSTEM

- A. Fabricair Dispersion System shall be constructed of FabricAir® Combi 70 fabric. The fabric is a woven fire retardant and permeable fabric complying with the following characteristics:
1. Fabric: 100% Flame Retardant Polyester
 2. Weight: 8.5 oz./yd² per ASTM D3776
 3. Shrinkage: Max. 0,5% per DIN EN 26 630
 4. Color: 3000 white, 3001 Blue, 3002 Orange, 3003 Dark Gray, 3004 Black, 3005 Red, 3006 Light Gray, 3007 Green, 3008 Tan or custom
 5. Temperature Range: -40°F to +284°F
 6. Permeability: 2 (+/- 5%) per ASTM D737, Frazier – calandring of fabric NOT accepted
 7. Fire Retardancy: Must meet the requirements in NFPA 90-A.
- B. SYSTEMS FABRICATION REQUIREMENTS
1. The system is made with sewn in, but still removable, aluminum hoops. The rods support the shape of the fabric system by 180° (8"-48"), 120° (49"-60"), 90° (61"-68") and 60° (69"-80"). Hoops must be pre-installed from factory, no installation at sight. Diameter of hoops and distance between as specified by manufacturer.
 2. Elbows of 70° or more to have 2 hoops sewn in order to maintain shape.
 3. Air dispersion accomplished by linear slots and permeable fabric. Linear slots (vents) are to consist of a coated mesh rather than an array of open orifices in order to reduce the risk of tear. Maximum allowed size of each opening in mesh to be 1/32". Due to exact requirements of throw and maximum level of noise alternative flow models are not acceptable.
 4. Color of mesh must match color of fabric. Unless otherwise specifically mentioned on drawings or otherwise in this specification suppliers standard table is used for selection of color.
 5. Location and number of mesh to be specified and approved by manufacturer
 6. The system is made of permeable fabric. Permeability of fabric must be reached based on weave construction only and weave must have gone through thermo fixation in order to secure same permeability after wash. Fabric with permeability obtained based on calandring is not accepted.
 7. Provide system in sections optimized for maintenance, connected by zippers. Zippers must provide closure completely around the circumference to prevent leakage. Required number of zippers as specified by manufacturer.
 8. Each section to have a unique tag including information about: manufacturers order number, position, diameter of section, length of section, maintenance instruction, code compliance and contact details for spare parts.
 9. Fabric system shall include connectors to attach to suspension system listed below.
- C. DESIGN PARAMETERS
1. Fabric diffusers shall be designed from minimum 0.25" water gage to 3" as the maximum – 0.5" being the standard.
 2. Design temperatures between -40°F and 284°F
 3. Manufacturer shall review and approve all technical design parameters.
- D. HANGERS AND SUPPORT
1. Where fabric duct is shown, contractor to provide vendor designed hangers and supports.
 2. Hardware Options
 - a. Plastic Coated Stainless Steel Cable – all other components Stainless Steel
 - b. Stainless Steel Cable – all other components Stainless Steel
 - c. Plastic Coated Galvanized Cable – all other components Galvanized Steel
 3. Two rows cable system located 1.5" above 3 & 9 o'clock of FabricAir® system. FabricAir® system to be attached to hardware using two rows of plastic hooks located 3 & 9 o'clock spaced 20 inches. Hardware to include cable, cable clamps, turnbuckles, and tie down straps as required.
- E. DELIGATED DESIGN REQUIREMENTS
1. Systems are specified under performance criteria, vendor to provide a system that meets the performance criteria and noted on the drawings.

PART 3 - INSTALLATION

3.1 INSTALLATION OF FABRICAIR® SYSTEM

- A. Examine area and conditions under which the fabric duct system are to be installed. Do not continue any installation until unsatisfactory conditions have been corrected.
- B. Install chosen suspension system in accordance with the requirements of the manufacturer. Installation instructions to be provided by the manufacturer with product.
- C. Coordinate layout with suspended ceiling, lighting layouts, and similar finished work.

3.2 CLEANING

- A. Clean air handling unit and other ductwork prior to the FabricAir® system as it is installed. Make sure that all dust from installation are removed from the air handling unit and other ductwork before connecting the FabricAir® system.
- B. If the fabric duct system becomes soiled during the installation, it should be removed and cleaned following the manufacturers cleaning instructions.

END OF SECTION 23 37 16

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SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies fan coil units for concealed overhead or exposed installation.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- 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. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 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. Units shall be ARI 440 certified and labeled.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/ IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

- A. Provide one (1) year manufacturer's warranty. Include coverage of fan-coil unit and motors.

1.5 DEFINITION

- A. Exposed cabinet is defined as a unit that does not have supply or return duct connections, but has integral supply and return registers.

1.6 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. Fan-Coil-Unit Filters: Install new filters at substantial completion per Part 3 of this specification. Furnish one additional spare filters for each filter installed to be used by Owner after substantial completion.
 - 2. Fan Belts: Furnish one spare fan belt for each unit installed

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide scheduled products by one of the following:
 - 1. Daikin
 - 2. Enviro-Tec, Inc.
 - 3. Greenheck
 - 4. International Environmental Corporation.

5. Johnson Controls
6. Temtrol
7. Zehnder Rittling

2.2 DIRECT DRIVE FAN-COIL UNITS

- A. Cabinet. Construct of heavy gauge galvanized steel panels. Exposed units shall be finished with a heat cured anodic acrylic powder paint of the standard factory color. All units shall be insulated with 1/2-inch, 1-1/2 pound [foil faced] fiberglass insulation meeting NFPA 90A requirements. Insulate coil and fan sections. Seal insulation edges.
- B. Access. Exposed units shall have fan and filter access panel attached with quarter turn quick open fasteners for access to service.
- C. Fan. Unit fan shall be a dynamically balanced, forwardly curved, DWDI centrifugal type constructed of 18 gauge zinc coated galvanized steel for corrosion resistance. The fan assembly shall be easily removable for servicing the motor and blower at, or away from the unit. Fan assemblies shall be easily serviced through an access panel provided.
- D. Motor. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL and CSA listed automatic reset thermal overload protection and three separate horsepower taps. Single speed motors are not acceptable.
- E. Hydronic Coil. 1/2 inch copper tube, 0.016-inch tube wall thickness, with mechanically bonded aluminum fins spaced no closer than 12 fins/inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220°F. Include manual air vent and drain valve.
- F. Drain Pan. Primary condensate drain pans shall be single wall, heavy gauge stainless steel for corrosion resistance, and extend under the entire cooling coil. Drain pans shall be of one-piece construction and be positively sloped for condensate removal. Drain pans on concealed models shall be field reversible for right or left hand connections. The drain pan shall be externally insulated with a fire retardant, closed cell foam insulation. The insulation shall carry no more than a 25/50 Flame Spread and Smoke Developed Rating per ASTM E-84 and UL 723 and an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21
- G. Filters. All plenum and exposed units shall be furnished with a minimum 1" pleated MERV 8 filter. Filters shall be tight fitting to prevent air bypass. Plenum unit filters shall be easily removable from the bottom of the unit without the need for tools.
- H. Electrical. Units shall be furnished with single point power connection. Provide an electrical junction box with terminal strip for motor and other electrical terminations. The factory mounted terminal wiring strip consists of a multiple position screw terminal block to facilitate wiring terminations for the electric control valves and thermostats. Provide unit mounted three speed fan and disconnect switch.
- I. Controls: All controls, including terminal equipment controller for fan coil unit shall be supplied by the Temperature Controls Contractor to fan coil unit manufacturer for factory installation.
- J. Supply plenum. Provide a fully insulated integral supply plenum section complete with double deflection supply grille.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan-coil units to comply with NFPA 90A.
- B. Mount fan-coil units on floor with vibration isolators as specified in Section 23 05 48, Vibration Isolation for HVAC Piping and Equipment.
- C. Verify locations of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Install new filters in each fan-coil unit at Substantial Completion.

- E. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
 - 3. Connect condensate drain to indirect waste. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 82 19

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SECTION 26 00 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide labor, materials and equipment required for complete and functioning electrical systems as required by the contract documents.
- B. New Work. The work includes, but is not limited to, the following principal systems and equipment:
 - 1. 480/277 volt distribution.
 - 2. 208/120 volt distribution.
 - 3. Switchboards.
 - 4. Panelboards-Distribution, Branch Circuit and Electronic Grade.
 - 5. Transformers-General purpose and K-factor.
 - 6. Automatic transfer switches.
 - 7. Luminaires, poles, lamps and ballasts.
 - 8. Packaged electric generating system.
 - 9. Lightning protection system.
 - 10. Fire alarm system.
 - 11. Underground duct banks.
 - 12. Bypass-isolation switches.
 - 13. Power factor correction.
 - 14. Lighting controls.
 - 15. Digital addressable lighting control system.
 - 16. Grounding and bonding system.
 - 17. Motor controllers.
 - 18. Variable frequency drives for AC electric motors. Furnished by Division 23, installed by Division 26.
 - 19. Electric motors. Furnished and installed by Divisions 21, 22 and 23. Electrical connections by Division 26.
- C. Empty Raceway. Refer to Division 27 telephone/data and Division 28 security specifications for cabling requirements. Provide empty raceway for the following systems per ANSI/TIA-569-C:
 - 1. Communications: Computer system cables and outlets. Refer to telecommunications Drawings for additional work.
 - 2. Communications: Telephone system cables and outlets. Refer to telecommunications Drawings from additional work.
 - 3. Security system cables and devices. Refer to Security Drawings for additional work.
- D. Demolition. Refer to demolition Drawings and Section 26 01 00 for scope of work.

1.02 APPLICABLE PROVISIONS

- A. Provisions Specified Elsewhere. Unless modified in this Section, General and Supplementary General Conditions, applicable provisions of Division 01 - General and other provisions of contract documents apply to work of Division 26 - Electrical.
- B. Application. Provisions of this Section apply to every section of Division 26 - Electrical, except where specifically modified.
- C. Work covered by this Section shall be accomplished in accordance with applicable provisions of the Contract Documents and addenda or directives which may be issued herewith, or otherwise.

1.03 RELATED WORK

- A. Existing Conditions - Division 02.
- B. Site Work – Division 02.
- C. Concrete - Division 03.
- D. Sealing and Firestopping – Division 07.
- E. Openings - Division 08.
- F. Finishes - Division 09.
- G. Equipment - Division 11.
- H. Furnishings – Division 12.
- I. Special Construction – Division 13.
- J. Conveying Equipment – Division 14.
- K. Fire Protection – Division 21.
- L. Plumbing – Division 22.
- M. Heating, Ventilation and Air Conditioning – Division 23.
- N. Communications – Division 27.
- O. Electronic Safety and Security – Division 28.
- P. Utilities – Division 33.

1.04 REFERENCE CODES AND STANDARDS

- A. Standards of the following organizations may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.
- B. Association of Edison Illuminating Companies (AEIC).
- C. American National Standards Institute (ANSI).
- D. Institute of Electrical and Electronics Engineers (IEEE).
- E. Insulated Cable Engineers Association (ICEA).
- F. National Electrical Code (NEC).
- G. National Electrical Manufacturers Association (NEMA).
- H. National Electrical Safety Code (NESC).
- I. National Fire Protection Association (NFPA).

- J. Underwriters' Laboratories (UL).
- K. ASHRAE/IESNA 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.05 REGULATIONS AND PERMITS

- A. Regulations. Work, materials and equipment must comply with the latest rules and regulations of the following:
 - 1. 2014 National Electrical Code (NEC).
 - 2. 2013 ASHRAE 90.1 (Energy Code)
 - 3. 2012 National Fire Protection Association (NFPA)
 - 4. 2012 National Electrical Safety Code (NESC).
 - 5. Occupational Safety and Health Act (OSHA).
 - 6. Americans with Disabilities Act (ADA).
 - 7. Texas Department of Licensing and Regulation (TDLR).
 - 8. Texas Occupational Code.
 - 9. Texas Electrical Safety and Licensing Act – Title 8, Occupations Code Chapter 1305.
 - 10. State and federal codes, ordinances and regulations.
- B. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing, including a proposed resolution, and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.
- C. Permits: Obtain certificates of inspection and other permits required as a part of the work. Submit written evidence to the Owner's Representative and Architect/Engineer that the required permits and inspections have been secured.

1.06 DRAWINGS AND CONTRACT DOCUMENTS

- A. Intent: The intent of the construction Drawings or contract documents, hereinafter referred to as the "Drawings", is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. The Drawings, specifications, and related contract documents are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Electrical Drawings, are generally diagrammatic and show approximate location and extent of the work. Review pertinent Drawings and adjust the work to conditions shown. Install the work complete, including minor details necessary to perform the function indicated.
- B. The Contractor shall carefully investigate structural and finish conditions, and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceways, subject to prior review by the Owner's Representative. Work shall be organized and laid out in finished portions of the building so that it will be concealed in furred chases, suspended ceilings, and similar elements of the building, unless specifically noted to be exposed. Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. Discrepancies: In case of doubt as to work intended, or if amplification or clarification is needed, or where discrepancies occur between Drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer and the Owner's Representative in writing, requesting an interpretation, and include a proposed solution.

- D. Dimensions: Dimensional information related to new structures shall be taken from the appropriate Drawings. Dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- E. Outlet and Equipment Locations: Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, telecommunications, audio-visual (AV), security, plumbing, and laboratory Drawings. Review with the Owner's Representative proposed changes in outlet and equipment location. Relocation of outlets before installation of up to 5 feet from the position indicated may be directed without additional cost to the Owner. Remove and replace outlets placed in unsuitable locations, when so requested by the Owner's Representative, and at no additional cost to Owner.

1.07 SUBMITTALS

- A. Submit the following in addition to and in accordance with the requirements of the Uniform General Conditions and in Division 01, Submittals.
 - 1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
 - 2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions are clearly indicated and non-applicable portions clearly deleted or crossed out.
 - 3. Schematic, connection and/or interconnection diagrams.
 - 4. Provide submittals as required by individual specification section.
- B. Provide the following with each submittal:
 - 1. Catalog cutsheets with manufacturer's name clearly indicated. Applicable portions shall be clearly indicated by arrows, circles, or similar markings and non-applicable portions shall be clearly deleted or crossed out.
 - 2. Line-by-line specification review by equipment manufacturer and contractor with exceptions explicitly defined.
 - 3. Itemize and organize equipment and material submittals by specification Section number; include manufacturer and identifying model or catalog numbers.
 - a. Submittal packages for product data, shop drawings, and other required submittals shall be numbered sequentially according to the applicable specification Section number. For example, the first submittal package for Energy-Efficient Dry-Type Transformers shall be identified as Submittal number 262213-01. The second submittal package for Energy-Efficient Dry-Type Transformers would be identified as Submittal number 262213-02. Re-submittal packages shall be identified by an "R" in the sequential numerical suffix.
 - b. Where directed by the Owner or the Architect to combine submittals into a common package, the submittal data may be organized in one or more 3-ring binders or similar container. Product data, shop drawings, and other submittal data shall be organized in separate tabs according to paragraph 1.07B.3a, above. That is, submittal data in individual tabs of a common submittal package shall be numbered sequentially, according to the applicable specification Section number.
 - 4. Replace rejected items and resubmit with acceptable items in accordance with the requirements of Division 01 for Submittals, and with the Uniform General Conditions.
- C. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.
 - 1. Itemize equipment and material by specification section number; include manufacturer and identifying model or catalog numbers.
 - 2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.

3. If a satisfactory replacement is not submitted within a two-week period, Owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at not additional cost to Owner.
- D. Equipment Layout Drawing: 1/8-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads shall be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings.
- E. Coordination Drawings: The Contractor shall prepare one complete set of composite drawings. The shop drawings for sheet metal ductwork shall be used as the basis for this coordination. When the sheet metal drawings have been prepared, the raceway, luminaires, mechanical piping, plumbing piping, and fire protection piping shall be overlaid and drafted onto the composite drawing. The intent of this process is to define areas of potential conflict and resolve those conflicts prior to fabrication or installation of work. In areas of congestion (where simply overlaying and drafting will create an unreadable product), the plan view scale shall be increased and multiple layered views shall be developed. Elevations of the individual elements shall be established, and elevations shall be drawn to illustrate that the ductwork, piping, raceway, and other systems and components will co-exist within the available space, and that the proper access to equipment, luminaires, valves, filters, etc. has been established for operation, service, removal and replacement. In addition to the above, the Contractor shall also submit the following for review:
 1. Electrical and Telecommunications Rooms. Submit 1/4-inch scale coordination drawings of electrical and telecommunications rooms indicating location of equipment. Indicate the exact location of each component in relation to other mechanical, electrical, and plumbing (MEP) components within each room. Include location(s) and quantity of raceway(s) and sleeve(s) stubbed up through floor slab for power, lighting, control, grounding, communications, and low-voltage system(s). These coordination drawings shall take into account the configuration of the mechanical, electrical, and telecommunications equipment which has been proposed and approved for use in the project, particularly where it differs in configuration from the equipment shown on the Drawings.
 2. Mechanical and Pump Rooms. Submit 1/4-inch scale coordination drawings of mechanical and pump rooms indicating location of electrical equipment. Indicate the exact location of each component in relation to other MEP components within each mechanical and pump room. These coordination drawings shall take into account the configuration of the mechanical and electrical equipment which has been proposed and approved for use in the project, particularly where it differs in configuration from the equipment shown on the Drawings.
 3. Auditorium, Lecture, Conference and Audio-Visual (A/V) Rooms. Submit 1/8-inch scale coordination drawings showing receptacles, snap switches, occupancy sensors, lighting controls, dimmers, communication outlets, and Audio-Visual (AV) outlets and devices (including projector mounts). Indicate locations and mounting heights of outlets and devices. Electrical, communication and AV devices shown in proximity to each other shall be grouped.
 4. Corridors. Submit 1/4-inch scale coordination drawings, including sections, of corridors indicating equipment and material.
 5. Building Information Modeling (BIM). Where a BIM-model of the project has been developed by the Architect/Engineer or Contractor, the BIM model may be used to develop and produce the coordination drawings. The Contractor and the individual trades shall confirm in writing that the BIM-model and related coordination drawings accurately match the components and systems to be fabricated and installed.
 6. Review: The completed "Composite Drawings" shall be submitted to the Architect/Engineer for review prior to installation. Work that proceeds without appropriate coordination and review will be subject to removal and relocation at no additional cost to the Owner.

- F. Installation: Where product data or shop drawings are required, do not install equipment or materials until submittals are accepted by the Architect/Engineer and by Owner's Representative. Use only equipment and materials accepted by the Architect/Engineer and by Owner's Representative. Equipment and materials installed prior to acceptance by the Owner/ Engineer and Owner's Representative shall be removed at no additional cost to Owner and replaced at the Contractor's expense.
- G. Startup and Test Procedures:
1. Furnish documentation from equipment manufacturer for the startup and field testing procedures for equipment installed as a part of this project.
 2. Startup and testing procedures shall include prerequisite conditions, system and equipment alignments and lineups, sequential steps for execution of the test, shutdown procedures, and criteria for satisfactory test completion and test failure.
 3. Startup and testing procedures shall address and demonstrate modes of system or equipment operation, including startup, manual, unattended/automatic, and shutdown procedures, as well as procedures for testing and demonstration of abnormal or emergency operating conditions.
 4. Include forms and logs to be used during field testing. Forms and logs shall include the range of permissible values for monitored parameters, as applicable.
- H. As-Built and Record Drawings:
1. Maintain a master set of as-built drawings that show changes and other deviations from the Drawings. The markups must be made as the changes are done.
 2. At the conclusion of the project, these as-built drawings shall be transferred to AutoCAD electronic files, in a format acceptable to the Owner's Representative, and shall be complete.
 3. Prior to final acceptance, deliver to the Owner's Representative the AutoCAD electronic files, the complete set of record drawings showing the as-built condition of the project, and the actual field set of as-built drawings. Also deliver one set of as-built drawings on CD-Rom or similar electronic media acceptable to the Owner. Drawing files shall be in AutoCAD (.dwg) and Adobe Acrobat (.pdf).
 4. Quantity: In accordance with the requirements of Division 01 and the General Conditions. Where not specified elsewhere, provide 3 hard copies plus one reproducible set.
- I. Operating and Maintenance Manuals: As specified in Part 3 of this Section and in Division 01, as applicable.
- J. Overcurrent Protective Device Coordination Study: Provide preliminary and final study as specified in Section 26 05 73. Make adjustments to materials and submittals under other Sections of Division 26 as required and as recommended by the Overcurrent Protective Device Coordination studies.

1.08 SUBSTITUTIONS

- A. Refer to requirements of Division 01 for substitution of Material and Equipment.
- B. Product manufacturers are listed to establish a level of quality for the products. Substitutions may be allowed if the product is equal to or better than what is listed in the design guidelines, as determined by the Architect/Engineer and owner's Representative upon submittal of comparison products.
- C. Samples: When requested by the Owner's Representative or the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. When requested, provide samples of both the specified item and the proposed item for comparison purposes.

- D. **Timeliness:** The burden of timeliness in the complete cycle of submittal data, shop drawings, and sample processing is on the Contractor. Time periods for Architect/Engineer processing and review of submittal data, shop drawings, samples, studies, and reports shall be in accordance with the applicable submittal and substitution requirements of Division 01 and the General Conditions. The Contractor shall allow sufficient time for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles for processing of submittal data and shop drawings, including time for resubmittal cycles on unacceptable and rejected materials, equipment, components, and systems covered by the data submitted. Construction delays and lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in requests for scheduled construction time extensions and additional costs to the Owner.
- E. **Acceptance:** Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop drawings indicating compliance with the Drawings, specifications, and other applicable Contract Documents, and that adequate and acceptable clearances will exist for entry, servicing, and maintenance. Acceptance of materials and equipment under this provision shall not be construed as authorizing deviations from the Specifications, unless the attention of the Owner's Representative and the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless pertinent information is properly identified.
- F. **Replacement;** Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment originally specified at no additional cost to the Owner.

1.09 CONTRACTOR QUALIFICATIONS

- A. An acceptable Contractor for the work under this division must have personnel with experience, training and skill to provide a practical working system.
 - 1. The Contractor may be required to furnish acceptable evidence of having installed not less than three systems of size and type comparable to this project. The systems must have served satisfactorily for not less than 3 years. The superintendent must have had experience in installing not less than three such systems.
 - 2. The Contractor must have personnel with the proper licenses to perform electrical work under this Contract. In accordance with the Texas Electrical Safety and Licensing Act – Title 8, Occupation Code, Chapter 1305, Subchapter D, section 1305.151: "LICENSE REQUIRED. Except as provided by Section 1305.003, a person may not perform electrical work unless the person holds an appropriate license issued or recognized under this chapter."
- B. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of the Project Safety Manual (PSM).
 - 1. The Contractor shall be responsible for training personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
 - 2. The Contractor shall secure electrical rooms, to limit access, prior to energizing high voltage (1000V or higher) equipment, and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is ongoing near energized equipment. The Contractor shall cover energized live parts when work is not being done in the equipment. This includes lunch and breaks.

3. The Contractor shall strictly enforce OSHA lockout/tagout procedures. Initial infractions shall result in a warning. A second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Condition. Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.
- B. NEC and UL.
 1. Products must conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.
 2. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Where no specifications or specific model numbers are given, provide materials of a standard industrial quality.
- C. Space Limitations: Equipment selected must conform to the building features and must be coordinated with them. Electrical installation shall comply with the requirements of Article 110.26 and Article 110.34 of the National Electric Code (NEC) for working space, access, and dedicated equipment space. Do not provide equipment that will not suit arrangement and space limitations. Scaled drawings (1/4" = 1'-0") of electrical and telecommunication rooms shall be submitted for review by the Architect/Engineer and the Owner's Representative prior to installing equipment. See paragraph 1.07E above.
- D. Factory Finish. Equipment shall be delivered with a hard surface, factory-applied finish so that no additional field painting is required except for touch-up as required.
- E. Physical Size of Equipment: Equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless the Contractor demonstrates by product data, shop drawings, and coordination drawings that ample space exists for proper installation, operation, and maintenance.
- F. Enclosure: Provide NEMA 1 enclosure for indoor installation and NEMA 4X for outdoor enclosure, unless noted or specified otherwise. The enclosure shall be suitable for the environment per NEC, NEMA and ANSI standards.
- G. Conductors in Conduit: Conductors shall be installed in conduit. Exceptions are listed in individual Sections of the Division 26 and Division 28 specifications.

2.02 MANUFACTURER

- A. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer, except as specifically noted in individual Sections of the specifications.

- B. Common Source:
 - 1. Generator, Automatic Transfer Switches, and Bypass-Isolation Switches: Equipment specified in Sections 26 32 14, 26 36 23, and 26 36 25 shall be provided by the same supplier, and shall be the responsibility of the supplier for the packaged electric generating plant. Responsibility for warranty service shall not be a justification for substitution of products of a manufacturer other than those listed for equipment in the individual Sections 26 32 14, 26 36 23, and 26 36 25.

2.03 SUBSTITUTIONS

- A. Refer to Division 01 section on Material and Equipment, and to paragraph 1.08 of this Section.

2.04 NAMEPLATES AND DEVICE MARKING

- A. Refer to Section 26 05 53, Identification For Electrical Systems.

2.05 AUTOMATED EQUIPMENT AND CONTROLS

- A. Equipment and control systems where applicable, shall match, integrate, communicate and cooperate with new and existing systems, such as building automation, energy management, direct digital controls (DDC), fire detection and alarm, circuit breakers, transformers, etc.

PART 3 - EXECUTION

3.01 GENERAL

- A. Manufacturer's Recommendations: The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, wiring, and connection of equipment and material. Promptly notify the Architect/Engineer and the Owner's Representative in writing of conflicts between the requirements of the Drawings and specifications and the manufacturer's directions, in accordance with paragraphs 1.05B and 1.06C of this Section. Obtain instructions from the Owner's Representative before proceeding with the work. Should the Contractor perform work that does not comply with the manufacturer's directions or such instructions from the Owner's Representative, he shall bear costs arising in connection with the deficiencies.
- B. Site Observation: Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Drawings, specifications, and other applicable Contract Documents. Site observation by the Architect/Engineer shall not be construed as construction supervision, or indication of approval of the manner or location in which the work is being performed, or as being a safe practice or place. Site observation by the Architect/ Engineer shall not be construed as inspection by the Authority Having Jurisdiction (AHJ) or other applicable code enforcement authority.
- C. Installation:
 - 1. The Contractor must have personnel with the proper licenses to perform electrical work under this Contract. In accordance with the Texas Electrical Safety and Licensing Act – Title 8, Occupation Code, Chapter 1305, Subchapter D, section 1305.151: "LICENSE REQUIRED. Except as provided by Section 1305.003, a person may not perform electrical work unless the person holds an appropriate license issued or recognized under this chapter."
 - 2. Where product data or shop drawings are required, do not install equipment or materials until submittals are accepted by the Architect/Engineer and by the Owner's Representative. Use only equipment and materials accepted by the Architect/Engineer and the Owner's Representative. Equipment and materials installed prior to acceptance by the Architect/ Engineer and Owner's Representative shall be removed at no additional cost to Owner and replaced at the Contractor's expense.

D. Supervision:

1. The Contractor of the work under this Division shall keep a competent superintendent or foreman on the job throughout the period of construction. Refer to Division 01 requirements and the Uniform General Conditions for additional information concerning supervision.
2. It shall be the responsibility of such superintendent to study the Drawings, specifications, and other applicable Contract Documents, and familiarize himself with the work. He shall coordinate his work with other trades before material is fabricated or installed, and ensure that his work will not cause interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the Contractor. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the Architect/Engineer and the Owner's Representative for resolution in accordance with paragraphs 1.05B and 1.06C of this Section.

3.02 PROTECTION OF EQUIPMENT AND MATERIALS

A. General:

1. The Contractor shall follow the manufacturer's directions completely in the delivery, storage and handling of equipment and materials.
2. Equipment and materials shall be tightly covered and protected against dirt, water, chemical, physical or weather damage and theft. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and shall be returned to "as new" condition.
3. Electrical cable, conductors and equipment shall be stored to prevent moisture and mechanical damage in an area that is protected from wind, rain or other exterior elements. Prior to installation, the building must be "dried-in" to prevent damage as stated above.

B. Moisture. During construction, protect switchboard, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately on receiving the products and maintain continually. Equipment shall be protected against wind, rain or other exterior elements.

C. Clean. Keep products clean by elevating above ground or floor and by using suitable coverings.

D. Damage. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

E. Finish. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore finishes that become stained or damaged.

F. Weather. Protect equipment and materials from weather and sunlight by use of suitable coverings and storage indoors, or in suitable weather-protected containers. Materials and equipment marked by their manufacturer as suitable for storage outdoors may be stored according to manufacturer's markings. Maintain factory-installed coverings and wrappings until material is to be installed.

3.03 PREPARATION

- A. Coordination Drawings: The Contractor shall prepare one complete set of composite drawings. The shop drawings for sheet metal ductwork shall be used as the basis for this coordination. When the sheet metal drawings have been prepared, the raceway, luminaires, mechanical piping, plumbing piping, and fire protection piping shall be overlaid and drafted onto the composite drawing. The intent of this process is to define areas of potential conflict and resolve those conflicts prior to fabrication or installation of work. In areas of congestion (where simply overlaying and drafting will create an unreadable product), the plan view scale shall be increased and multiple layered views shall be developed. Elevations of the individual elements shall be established, and elevations shall be drawn to illustrate that the ductwork, piping, raceway, and other systems and components will co-exist within the available space, and that the proper access to equipment, luminaires, valves, filters, etc. has been established for operation, service, removal and replacement. In addition to the above, the Contractor shall also prepare the following:
1. Electrical and Telecommunications Rooms. Prepare 1/4-inch scale coordination drawings of electrical and telecommunications rooms indicating location of equipment. Indicate the exact location of each component in relation to other mechanical, electrical, and plumbing (MEP) components within each room. Include location(s) and quantity of raceway(s) and sleeve(s) stubbed up through floor slab for power, lighting, control, grounding, communications, and low-voltage system(s). These coordination drawings shall take into account the configuration of the mechanical, electrical, and telecommunications equipment which has been proposed for use in the project, particularly where it differs in configuration from the equipment shown on the Drawings.
 2. Mechanical and Pump Rooms. Prepare 1/4-inch scale coordination drawings of mechanical and pump rooms indicating location of electrical equipment. Indicate the exact location of each component in relation to other MEP components within each mechanical and pump room. These coordination drawings shall take into account the configuration of the mechanical and electrical equipment which has been proposed for use in the project, particularly where it differs in configuration from the equipment shown on the Drawings.
 3. Auditorium, Lecture, Conference and Audio-Visual (A/V) Rooms. Prepare 1/8-inch scale coordination drawings showing receptacles, snap switches, occupancy sensors, lighting controls, dimmers, communication outlets, and Audio-Visual (AV) outlets and devices (including projector mounts). Indicate locations and mounting heights of outlets and devices. Electrical, communication and AV devices shown in proximity to each other shall be grouped.
 4. Corridors. Prepare 1/4-inch scale coordination drawings, including sections, of corridors indicating equipment and material.
 5. Building Information Modeling (BIM). Where a BIM-model of the project has been developed by the Architect/Engineer or Contractor, the BIM model may be used to develop and produce the coordination drawings. The Contractor and the individual trades shall confirm in writing that the BIM-model and related coordination drawings accurately match the components and systems to be fabricated and installed.
 6. Review: The completed "Composite Drawings" shall be prepared prior to installation. Work that proceeds without appropriate coordination will be subject to removal and relocation at no additional cost to the Owner.
- B. Test Procedures:
1. Furnish documentation from equipment manufacturer for the startup and field testing procedures for equipment installed as a part of this project.
 2. Startup and testing procedures shall include prerequisite conditions, system and equipment alignments and lineups, sequential steps for execution of the test, shutdown procedures, and criteria for satisfactory test completion and test failure.
 3. Startup and testing procedures shall address and demonstrate modes of system or equipment operation, including startup, manual, unattended/automatic, and shutdown procedures, as well as procedures for testing and demonstration of abnormal or emergency operating conditions.

4. Include forms and logs to be used during field testing. Forms and logs shall include the range of permissible values for monitored parameters, as applicable.

3.04 SAFETY

- A. Implement the following safety procedures in addition to, and in accordance with, the requirements of Division 01 and the Uniform General Conditions:
 1. The Contractor shall be responsible for training personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel of hazards particular to this project and update the information as the project progresses.
 2. Prior to energizing panelboards within the scope of work, secure affected electrical rooms to limit access to line voltage. Line voltage shall be defined as above 50 volts, for the purpose of controlling access. During and after energization of panelboards, control access to electrical rooms for the duration of the project. Post and maintain warning and caution signage in areas where work is on-going near energized equipment. Cover energized live parts when work is not being done in the equipment. This includes lunch and breaks.
 3. Strictly enforce OSHA lockout/tagout procedures. Initial infractions shall result in a warning. A second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

3.05 INSPECTION

- A. Examination. Examine the areas and conditions under which equipment and systems are to be installed, and notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Coordination. Carefully investigate structural and finish conditions and coordinate the work in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases, suspended ceilings, and similar elements in finished portions of the building, unless specifically noted to be exposed. Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

3.06 INSTALLATION

- A. Cooperation with Other Trades. Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades. Provide other trades, as required, templates, patterns, setting plans and shop details for the proper installation of the work and for purposes of coordinating adjacent work. Electrical power connections for mechanical and plumbing equipment are in this Division unless noted otherwise. Verify electrical characteristics of equipment with other Divisions before roughing in the electrical connections.
- B. Workmanship. Work shall be performed by workmen skilled in their trade. The installation shall be complete and installed in a neat and workmanlike manner in accordance with NEC 110.12 and FPM accompanying, and as described in ANSI/NECA 1-2000 "Standard Practices for Good Workmanship in Electrical Contracting" and other ANSI approved installation standards.
- C. Concrete Equipment Pads.
 1. Refer to structural Drawings and specifications for design criteria.

2. Where not otherwise indicated, install 4 inch thick reinforced concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required. For equipment mounted outdoors, provide concrete foundations a minimum of 6 inches above grade. Provide reinforcing steel as recommended by the structural engineer and as detailed on the Drawings. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 4 inches beyond equipment. Trowel pads smooth with a slope per manufacturer's recommendations and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.
 3. Anchor Bolts. Furnish and install galvanized anchor bolts for equipment embedded within the concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.
- D. Setting of Equipment. Provide permanent and temporary shoring, anchoring, and bracing required to make parts stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.
1. Equipment must be leveled and set plumb.
 2. Sheet metal enclosures mounted against a wall shall be separated from the wall not less than 1/4 inch by means of corrosion-resistant spacers, or by 3 inches of air for freestanding units. Use corrosion-resistant bolts, nuts and washers to anchor equipment.
 3. In sufficient time to be coordinated with work under other divisions, provide shop drawings and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.
 4. Provide adequate support for freestanding panels, switchboards, enclosures, and other equipment. This shall include bolting to the floor, concrete equipment pad, or solid structural steel to prevent tipping. Install free-standing electrical equipment on concrete equipment pads in accordance with paragraph 3.05C, this Section, except where equipment is noted and designed for mounting directly on the concrete floor slab. Under no condition shall equipment be fastened to non-rigid building steel such as removable platform steel gratings, handrails, etc.
 5. Provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. Do not mount or suspend equipment from supports provided for equipment and systems by other Divisions, except where specifically noted or indicated on Drawings.
 6. Refer to Section 26 05 29, Metal Framing and supports, for additional requirements.
 7. Provide permanently marked NEC required clear space in front of and behind electrical equipment. Install markings on the floor using the color scheme conforming to ANSI Z535.1 for black and white striped border. Omit where installed in carpeted areas. Install space clearance labels where floor markings are not practical.
- E. Sealing of Equipment. Seal openings into equipment to prevent entrance of animals, birds and insects, as well as to prevent ingress of moisture, dust, dirt, and similar contaminants.
- F. Motors.
1. Motors are specified in Divisions 21, 22 and 23.
 2. Electrical work includes the electrical connection of motors, except those which are wired as a part of equipment.
 3. Refer to Division 23 and other applicable Divisions for wiring and connection of motors and equipment furnished by those Divisions.
 4. The Contractor shall note that the electrical Drawings are based on the equipment scheduled and indicated on the Drawings. Should mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

5. Provide interconnecting wiring for the installation of the power required. Provide disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. Combination starters, individual starters, and other motor starting apparatus, not specifically scheduled or specified as provided by the equipment manufacturer under the scope of other Divisions shall be provided under the scope of Division 26.
 6. Other Divisions will provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review. Diagrams will be based on accepted equipment and be complete full phase and interlock control drawings, not a series of manufacturer's individual diagrams. They will be followed in detail. For additional clarification, refer to Division 23, Controls.
- G. Concealed Work. Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings except:
1. Where shown or specified to be exposed. Exposed is understood to mean open to view.
 2. Where exposure is necessary to the proper function.
 3. Where size of materials and equipment preclude concealment. Obtain the written consent of the Owner's Representative and the Architect/Engineer to leave materials exposed in finished spaces of the building.
- H. Application. Unless otherwise indicated, power will be utilized as follows:
1. 480 volts, three phase: motors 1 horsepower and larger.
 2. 120 volts, single phase: motors 3/4 horsepower and smaller.
 3. 277 volts, single phase: fan powered boxes.
 4. 120 volts, single phase: decorative lighting.
 5. 277 volts, single phase: fluorescent and high-intensity-discharge lighting.
 6. 120 volts, single phase: convenience outlets, dedicated equipment, lab-track terminal boxes without fans.
 7. 208 volts, single and three phase: specialty outlets.
 8. 480 volts, three phase: special power and equipment; verify for each unit of equipment.
- I. Transformers. Use transformers to change the service to the required utilization voltages.
- J. Connections to Equipment - Other than Division 26. For equipment furnished under other Divisions, and for equipment furnished by the Owner, provide final electrical connections to such items of equipment. Obtain detailed shop drawings of equipment from the applicable Division or supplier indicating the exact number and location of rough-in points. Such final shop drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Making adjustments to field conditions is considered a part of the work required.
1. Roughing-in: When roughing-in, provide electrical branch circuits to various items of equipment. Terminate at proper points as indicated on detailed equipment shop drawings, or as directed. Use Drawings accompanying these specifications only for general routing of circuiting. Do not use Drawings accompanying these specifications for rough-in locations.
 2. Final Connections: Millwork, casework, and similar equipment will include service fittings such as switches, duplex receptacles, data/communications outlets, and luminaires on the casework or equipment. Provide branch circuit connection to match electrical connection requirements of service fittings.
- K. Accessories. Offsets, fittings, expansion joints, anchors and accessories that are required for a complete system shall be provided, even if not specifically indicated on the Drawings or mentioned in the specifications. Offsets, transitions and changes in direction of conduit, cable trays, and raceways shall be made to maintain proper headroom. Provide pullboxes, fittings, etc., required as a result of these transitions and changes in direction.
- L. Observation prior to cover-up or seal-in of walls and ceilings. Perform the following in accordance with the applicable requirements of Division 01 and the General Conditions:

1. Prior to the installation of ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangement can be made for observation or inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide advance notice in accordance with the applicable requirements of Division 01 and the General Conditions. Where not specified, required, or directed elsewhere, provide not less than 10 working days' advance notice.
2. Above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. Electrical work at and above the ceiling, including items supported by the ceiling grid, shall be complete and installed in accordance with contract requirements, including power to luminaires, fans, and other powered items. The purpose of this inspection is to verify the completeness and quality of the installation of the electrical systems and other above ceiling special systems such as cable tray systems. The ceiling supports shall be in place so that access panel and luminaire locations are identifiable, and so that clearances and access provisions may be evaluated.
3. No ceiling materials may be installed until the resulting deficiency list from this inspection is completed and approved by the Owner's Representative.

- M. Finish. Coordinate with Division 09 to paint exposed conduit to match adjacent walls, unless otherwise directed.

3.07 EXISTING FACILITIES

- A. Responsibility. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and maintenance of electrical services for new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing such temporary protection upon completion of the work.
- B. Services. The Contractor shall provide temporary or new services to existing facilities or equipment as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Access. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, luminaries, air conditioning ductwork and equipment, etc., to provide this access, and shall reinstall same upon completion of work in the areas affected.
- D. Existing Devices. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, remove and reinstall in locations approved by the Architect/Engineer devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature controls, system devices, electrical switches, relays, luminaires, fixtures, piping, conduit, etc.
- E. Outages. Outages of services as required by the new installation will be permitted, but only at a time approved by the Owner. The Contractor shall coordinate with the Owner's Representative to arrange for service outages. The Contractor shall allow the Owner sufficient time to schedule for required outages, in accordance with the applicable requirements of Division 01 and the General Conditions. Where not specified, required or directed elsewhere, allow a minimum of 21 working days for the Owner to schedule for required outages. The time allowed for outages will not be during normal working hours or during hours of research and instruction, unless otherwise approved by the Owner's Representative. Costs of outages, including overtime charges, shall be included in the contract amount.

- F. Adjacent Facilities. Coordinate work among the various trades to minimize disruption to existing processes, procedures, and equipment in spaces adjacent to areas of demolition and renovation work. Coordinate with Owner's Representative to schedule work producing noise or structure-born vibrations, including but not limited to cutting, drilling, coring, and use of impact tools.

3.08 EQUIPMENT AND DEVICE MARKING

- A. Designations. Identify equipment, devices, feeders, branch circuits and similar items with the same designations as indicated on the Drawings.
- B. Nameplates. Externally mark electrical equipment with nameplates identifying each and the equipment served. Supply blank nameplates for spare units and spaces.
- C. Refer to Section 26 05 53 for additional requirements.

3.09 SLEEVES, PENETRATION, CUTTING AND PATCHING

- A. General. Cut and patch walls, floors, etc., resulting from work in existing construction. Provide for the timely placing of sleeves for raceway and exposed cabling passing through walls, partitions, beams, floors and roof while same are under construction. If openings, sleeves, and recesses are not properly installed and cutting and patching become necessary, it shall be done at no expense to the Owner. Secure permission from the Owner's Representative before cutting or patching a constructed or existing wall. Where roofs or walls are fire rated, penetrations shall be completely sealed using UL-listed materials and procedures sufficient to preserve the fire rating. Comply with special requirements of local authorities.
- B. Structure. Do not cut or core through structural beams, joists, load-bearing walls, grade beams, or similar load-bearing structure. Where limited space is available above the ceilings below concrete beams or other deep projections, notify the Owner's Representative in writing, including a proposed solution, and request a resolution. Approval shall be obtained from the Owner's Representative and the Architect/Engineer for each penetration.
- C. Penetrations.
 - 1. This contract requires core drilling of floor or wall penetrations as indicated on Drawings. Core drilling shall be in accordance with structural specifications. Floor penetrations shall include a sleeve that extends above the floor 2 inches, except where plugs and caps are specified or indicated flush with floor or foundation pad. Electrical penetrations shall be coordinated with structure during design, and shall be made in compliance with structural requirements specified in the structural Drawings and specifications. Field modifications are required to be reviewed and approved by structural engineer prior to installation.
 - 2. Penetrations shall be sealed in accordance with the requirements of Division 07, Firestopping. Coordinate with Division 07 to provide firestopping systems and materials that are compatible with the penetrations for systems and equipment furnished and installed under Division 26.
 - 3. Provide sleeves for conduit penetrations of smoke, fire, and sound rated partitions. Install sleeve with a minimum of 1 inch diameter where penetrating the exterior drywall.
 - 4. Provide proper sizing of sleeves or core-drilled holes to accommodate their through-penetrating items. In general, provide conduit sleeves two standard sizes larger than their through-penetrating items. Provide larger sleeves as required to allow passage of couplings for through-penetrating items.
- D. Sealing and Firestopping.
 - 1. Voids between sleeves or core-drilled holes and pipe passing through fire-rated assemblies shall be firestopped to meet the requirements of ASTM E814 or UL 1479, in accordance with Division 07 requirements for Firestopping.

2. Where the routing of cable tray passes through fire-rated walls, floors or other fire-rated boundaries, coordinate with Division 07 to provide removable firestopping system.
 3. Furnish and install UL Systems Classified, intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250° F, for the sealing of holes or voids created to extend electrical systems through fire rated floors and walls, in order to prevent the spread of smoke, fire, toxic gas or water.
 4. Fire barrier products shall be used to create through-penetration firestop systems as required. Firestop systems shall be listed in the Underwriter's Laboratories Building Materials Discovery, Through Penetration Firestop Systems (XHEZ).
 5. Install firestop materials and systems according to their UL Systems Classifications, manufacturer instructions, manufacturer recommendations, and the requirements of applicable Division 7 specifications.
- E. Conduit Sleeves. Conduit sleeve shall be two standard sizes larger than the size of conduit it serves, except where "Link Seal" casing seals are used in sleeves through walls below grade. Sleeves in floor shall extend a minimum of two inches above the finished floor. Conduit passing through concrete masonry walls above grade shall have 18-gauge galvanized steel sleeves. Sleeves set in concrete floor construction shall be at least 16-gauge galvanized steel except at conduit supports. Sleeves set in concrete floor construction supporting conduit risers shall be standard weight galvanized steel. Sleeves supporting conduit risers 3 inches and larger shall have three 6 inch long reinforcing rods welded at 120 degree spacing to the sleeve, and shall be installed embedded in the concrete or grouted to existing concrete. Where the conduit passes through a sleeve, no point of the conduit shall touch the sleeve. Seal around penetrations through sleeving as indicated under firestopping as specified herein, and in compliance with the requirements of Division 07 specifications.
- F. Penetrations Below Grade. Sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be two inches wider in radius than the sleeve it encircles. The entire assembly shall be hot-dipped galvanized after fabrication. Seal off annular opening between conduit and sleeve with "Link Seal" casing seal as manufactured by Thunderline Corporation of Wayne, Michigan. Size conduit sleeve to accommodate the casing seal. Use Series 300 casing seals for pipe 3/4-inch through 4-inch and Series 400 casing seals for pipe sized 5-inch and larger.
- G. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and core drills, and at such locations acceptable to the Owner's Representative. Impact type equipment shall not be used except where specifically accepted by the Owner's Representative. Openings in precast concrete slabs for conduits, outlet boxes, etc., shall be core drilled to exact size.
- H. Restoration. Restore openings to "as new" condition under the appropriate specification Section for the materials involved, and match remaining surrounding materials and/or finishes.
- I. Masonry. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Provide adequate supports during the cutting operation to prevent damage to the masonry caused by the cutting operation. Structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner's Representative.
- J. Structure. No cutting, boring, or excavating which will weaken the structure shall be undertaken. Coordinate with structure for placement of conduit, sleeves, and the like through beams, joists, slabs, mats, and other structural components and systems prior to forming of those structural components and systems.

- K. Watertight. Where sleeves pass through roof or floors requiring waterproof membrane, lead flashing with a density of at least three pounds per square foot shall be built into the membrane a minimum of six inches to provide a watertight installation. Provide other watertight installation materials as detailed on the Drawings and as specified under Division 07 – Roofing.
- L. Escutcheons. Provide heavy chrome-plated or nickel-plated plates on conduit passing through walls and ceilings in finished areas. Escutcheons shall be B&C No. 10, or accepted substitution, chrome-plated steel plates with concealed hinges.
- M. Roof Penetrations and Flashings. Furnish and install pipe, conduit and duct sleeves, and flashing compatible with the roofing installation for roof penetrations. Coordinate with Division 07.

3.10 CLEANING, ADJUSTING AND START-UP

- A. Cleaning. Clean electrical equipment, components, and devices prior to installation of final finish or covers, prior to startup and testing, prior to final observation by Architect/Engineer and Owner's Representative, and as required under individual Sections of the Division 26 specifications.
- B. Adjusting. Adjust equipment, devices, and systems as specified under individual Sections of these Specifications and in accordance with manufacturer's instructions for proper functioning during modes of operation, including emergency and shutdown conditions.
- C. Factory Authorized Representative. Where specified for an individual item of electrical equipment, provide a factory authorized representative for adjustment, start-up, and testing of equipment, and instruction of Owner's operating personnel. Certify that these services have been performed by including a properly executed invoice for these services or a letter from the manufacturer.

3.11 TESTING

- A. Test Conditions. Use field startup and testing procedures submitted in accordance with paragraph 1.07H of this Section and accepted by the Owner's Representative and the Architect/Engineer. Place circuits and equipment into service under normal conditions, collectively and separately, as necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's Representative. Furnish instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Drawings and specifications. Special tests on certain items, when required, are specified in the individual specification Sections. Where testing is specified or otherwise required to be performed by an independent testing company, use an Owner-approved NETA-certified testing company.
- B. Test Conditions. Use field startup and testing procedures prepared in accordance with paragraph 3.03B of this Section. Place circuits and equipment into service under normal conditions, collectively and separately, as necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's Representative. Furnish instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Drawings and specifications. Special tests on certain items, when required, are specified in the individual specification Sections. Where testing is specified or otherwise required to be performed by an independent testing company, use an Owner-approved NETA-certified testing company.
- C. Test Dates. Schedule final acceptance tests sufficiently in advance of the contract completion date to permit adjustment and alterations within the number of days allotted for completion of the contract. Inform the Owner's Representative in advance of test dates in accordance with the applicable requirements of Division 01 and the General Conditions. Where not specified, required, or directed otherwise, allow a minimum of at least 10 working days advance notice.

- D. Retests. Conduct retests as directed by the Owner's Representative of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of equipment. Delays resulting from retests do not relieve the Contractor of his responsibility under this contract.
- E. Commissioning. Coordinate with commissioning agent, as applicable, for field testing and commissioning of electrical components and systems.
- F. Test Reports. Submit copies of test reports to the Architect/Engineer in accordance with Division 01 requirements.

3.12 OPERATING AND MAINTENANCE MANUALS

- A. General. The Contractor shall provide, in loose-leaf binders, complete operating and maintenance data of each manufactured item of equipment used in the electrical work at least four weeks before Architect/Engineer's final review and observation of the project. Descriptive data and printed installation, operating and maintenance instructions for each item of equipment will be included. A complete double index will be provided as follows.
- B. Format and content. The Operating and Maintenance Manual will be submitted in quantities and format as specified under Division 01 for Submittals. Provide quadruplicate where quantity is not specified. Operating and Maintenance Manual shall include:
 - 1. Descriptive data of each system and piece of equipment, including ratings, capacity, performance data, operating curves and characteristics, and wiring diagrams.
 - 2. Full detailed spare parts list, including source of supply for each piece of equipment. Where spare parts are not recommended by the manufacturer, indicate as such in the appropriate section.
 - 3. Printed instructions describing installation, operation, service, maintenance, and repair of each piece of equipment.
 - 4. Typewritten test and start-up reports of tests made of materials, equipment and systems under this Division. Test reports will include the dates of the tests, name of person conducting and witnessing the tests, and record of conditions relative to the tests.
 - 5. Copies of "Reviewed" shop drawings and submittals.
 - 6. Print copies of the record Drawings. Refer to paragraph 1.071 of this Section.

END OF SECTION 26 00 00

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SECTION 26 00 00.01.UT (PREVIOUSLY SECTION 16090) - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical demolition for remodeling.
- B. Electrical/control portion of HVAC work covered by Division 23 pertaining electrical demolition shall follow the requirement set forth by this specification.

1.2 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for minor electrical demolition for remodeling.
 - 1. Section 26 00 00.UT - Basic Electrical Requirements.
- B. In the event of conflict regarding minor electrical demolition requirements between this Section and any other Section, the provisions of this Section shall govern.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: as specified in individual Sections.
- B. Provide all materials necessary for work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. All demolitions or modifications to existing systems shall be coordinated through Owner's Representative. Demolition drawings are based on casual field observation and existing record documentations. Therefore the accuracy or exactness of the drawings is not guaranteed. The Contractor shall verify that field measurements and circuiting arrangements are as shown on Drawings and abandoned wiring and equipment serve only abandoned facilities. The Contractor shall be responsible for reporting discrepancies to Engineer before disturbing existing installation.
- B. Beginning of demolition means Contractor accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal. Provide temporary wiring and connections to maintain remaining systems in service during demolition and/or modification. Owner reserve the right up to 24 hours prior to any scheduled event to delay or suspend shutdowns or outages to more convenient times at no additional cost.
- B. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. No work shall begin without proper permits and authorizations. Disable system only to make switchovers and connections. Obtain permission from Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Provisions for manual fire watch shall be provided in areas where services are interrupted. Make temporary connections to maintain service in areas adjacent to work area.

- D. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new plan drawings.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes full length from source to device. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- D. Disconnect and remove abandoned panelboards and distribution equipment.
- E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- I. Extend existing installations using materials and methods compatible with existing electrical installation or as specified.
- J. The level of completion shall be demonstrated to Owner's Representative.
- K. Where equipment is indicated to be demolished and returned to Owner, the Contractor shall include the delivery of this equipment to the Owner's site storage area. Remove with care all equipment to be relocated. Repair or replace of newly damaged equipment is the responsibility of the Contractor.

3.4 CLEANING AND REPAIR

- A. The Contractor shall follow Owner's clean work policy and shall include the removal of trash and demolished material from the building or work area at the end of the each day and removal from the site once a week.
- B. The Contractor shall be responsible for repairing adjacent construction and finishes damaged during demolition and/or modification. The Contractor shall be responsible for the removal of ceiling tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of the ceiling prior to final acceptance.
- C. The Contractor shall be responsible for the removal of floor tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of new floor tile were floor boxes were removed prior to final acceptance.
- D. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- E. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.5 DISPOSITION OF MATERIAL AND EQUIPMENT

- A. Review with the Owner materials that have been removed and are no longer required, to determine any which the Owner may desire to keep. Deliver those materials that the Owner desires to the Owner's specified location.
- B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

END OF SECTION 26 00 00.01

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SECTION 26 00 00.UT (PREVIOUSLY SECTION 16010) - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General Requirements specifically applicable to Division 26.
- B. The Contractor shall be responsible for:
 - 1. The work included consists of furnishing all materials, supplies, equipment and tools, and performing all labor and services necessary for installation of a completely functional power, lighting, fire alarm and signaling systems. Complete systems in accordance with the intent of Contract Documents.
 - 2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.
 - 3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
 - 4. Temporary power service and lighting for construction. Coordinating all shutdown dates and schedules with Owner's Representative and obtain all work-permits required by Owner.
- C. Intent of Drawings:
 - 1. The Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every device or raceway in its exact location, unless specifically dimensioned. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceway, subject to prior review by the Owner and Engineer. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
 - 2. The intent of the Drawings is to establish the type of systems and functions, but not to set forth each item essential to the functioning of the system. The drawings and specifications are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Review pertinent drawings and adjust the work to conditions shown. In case of doubt as to work intended, or here discrepancies occur between drawings, specifications, and actual conditions, immediately notify the Architect/Engineer and the Owner's representative, and propose a resolution.

1.2 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total general requirements for the project electrical systems and equipment.
 - 1. Division 01 Sections included in the project specifications.
 - 2. The contract.

1.3 DESIGN CRITERIA

- A. Equipment and devices to be installed outdoors or in enclosures where the temperatures are not controlled shall be capable of continuous operation under such conditions per manufacturer's requirements.
- B. Compliance by the Contractor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.
- C. Electrical components shall be UL listed and labeled.

1.4 REFERENCE CODES AND STANDARDS, REGULATORY REQUIREMENTS

- A. Standards of the following organizations as well as those listed in Division 01, may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.
1. Association of Edison Illuminating Companies (AEIC)
 2. American National Standards Institute (ANSI)
 3. Institute of Electrical and Electronics Engineers (IEEE)
 4. Insulated Cable Engineers Association (ICEA)
 5. National Electrical Code (NEC)
 6. National Electrical Manufacturers Association (NEMA)
 7. Electrical Safety in the Workplace
 8. National Fire Protection Association (NFPA)
 9. Underwriter's Laboratories (UL)
 10. ASHRAE/IES 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- B. Work, materials and equipment must comply with the latest rules and regulations of the following.
1. National Electrical Code (NEC)
 2. Electrical Safety in the Workplace
 3. Occupational Safety and Health Act (OSHA)
 4. American with Disability Act (ADA)
 5. American Society for Testing and Materials (ASTM)
 6. University of Texas (UT) System
 7. Applicable state and federal codes, ordinances and regulations
- C. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified shown.
- D. Contractor shall obtain permits and arrange inspections required by codes applicable to this Section and shall submit written evidence to the Owner and Engineer that the required permits, inspections and code requirements have been secured.

1.5 SUBMITTALS

- A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.
1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
 2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of it are clearly indicated and non-applicable portions clearly deleted or crossed out.
 3. All schematic, connection and/or interconnection diagrams in accordance with the latest edition of NEMA.
 4. Provide submittals as required by individual specification Section.
- B. Provide the following with each submittal:
1. Catalog cuts with manufacturer's name clearly indicated. Applicable portions shall be circled and non-applicable portions shall be crossed out.
 2. Line-by-line specification review by equipment manufacturer and contractor with any exceptions explicitly defined.
- C. Equipment Layout Drawing: 1/8-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads should be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings.
- D. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.

1. Itemize equipment and material by specification Section number; include manufacturer and identifying model or catalog numbers.
2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.
3. If a satisfactory replacement is not submitted within a two-week period, owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at no additional cost to owner.

E. As-Built Record Drawings: The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCad electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance. Refer to 01210 Project Administration for other requirements.

1.6 SAFETY

- A. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of Project Safety Manual (PSM).
1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
 2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any high voltage (2.4KV or higher) switchgear and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is on going near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.
 3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

1.7 SHORING AND EQUIPMENT SUPPORTS

- A. The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required to make all parts absolutely stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.
- B. The Contractor shall adequately support all freestanding panels, motor control centers, enclosures, and other equipment. This shall include bolting to the floor or solid structural steel to prevent tipping. Install free-standing electrical equipment on 4" thick concrete housekeeping pads that are provided by others. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).
- C. The Contractor shall provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. At no time shall the Contractor mount or suspend equipment from other disciplines' supports.

1.8 TEMPORARY POWER REQUIREMENTS

- A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120-volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.
- B. Temporary power feeders shall originate from a distribution panel. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord.

- C. Branch circuits shall originate in an approved receptacle or panelboard. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord. Each branch circuit shall have a separate equipment grounding conductor.
- D. All receptacles shall be of the grounding type and electrically connected to the grounding conductor.
- E. Provide temporary lighting by factory-assembled lighting strings or by manually-assembled units. All lamps for general lighting shall be protected from accidental contact or breakage. Protection shall be provided by installing the lights a minimum of 7 feet from the work surface or by lamp holders with guards. Branch circuits supplying temporary lighting shall not supply any other load. Provide sufficient temporary lighting to ensure proper workmanship by combined use of day lighting, general lighting, and portable plug-in task lighting. Comply with OSHA required foot-candle levels and submit plan for approval by the owner.
- F. For temporary wiring over 600 volts, suitable fencing, barriers, or other effective means shall be provided to prevent access of anyone other than authorized and qualified personnel.
- G. Temporary power cords shall be kept off the ground or floor. The Contractor shall provide temporary supports as required to keep temporary cords off the ground or floor.

1.9 SUBSTITUTION OF MATERIALS AND EQUIPMENT:

- A. Refer to Uniform General Conditions and Supplementary General Conditions for substitution of materials and equipment.
- B. The intent of the Drawings and/or Specifications is neither to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- C. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.
- D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- E. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.
- F. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.
- G. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

- H. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- I. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- J. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Materials shall be of a standard industrial quality if no specifications or specific model numbers are given.
- B. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- C. All materials shall be new and unused.
- D. Provide non-metallic material in corrosive areas or as otherwise specified.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Install work in compliance with NEC latest edition.
- B. Install material and equipment in accordance with manufacturers' instructions. Provide calibrated torque wrenches and screwdrivers and tighten all terminals, lugs, and bus joints using it.
- C. Comply with startup procedures as defined by Construction Manager and Owner.
- D. Arrange electrical work in a neat, well-organized manner. Do not block future connection points of electrical service. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.
- E. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.
- F. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.

3.2 SERVICE CONTINUITY

- A. Maintain continuity of electric service to all functioning portions of process or buildings during the hours of normal use. Phase construction work to accommodate Owner's occupancy requirements.
- B. Arrange temporary outages for cutover work with the Owner. Keep the outages to a minimum number and minimum length of time.
- C. All service outages shall be requested in writing a minimum of two weeks prior to the date. Owner reserves the right to postpone shutdowns up to 24 hours prior to the shutdown at no additional cost. Outage requests shall include a schedule of the work to be performed and the time requirements.
- D. The Contractor shall obtain all appropriate Owner permits for working in equipment.

3.3 HAZARDOUS LOCATIONS

- A. Equipment, wiring, devices, and other components located within hazardous areas to be of appropriate type per NFPA requirements.
- B. Ground exposed non-current carrying parts of entire electrical system in hazardous areas, in accordance with NEC and as instructed by Owner.

3.4 SLEEVES AND SEALS

- A. Provide sealing and/or fire stopping where electrical equipment passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

3.5 CONSTRUCTION REVIEW

- A. The Engineer or Owner's representative will review and observe installation work to insure compliance by the Contractor with requirements of the Contract Documents.
- B. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.
- C. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

3.6 WARRANTY

- A. Provide warranties in accordance with the requirements of Uniform General and Supplementary Conditions (UGC).

END OF SECTION 26 00 00

SECTION 26 05 00.UT (PREVIOUSLY SECTION 16050) - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Hinged cover enclosures and cabinets
- B. Contactors
- C. Control relays
- D. Push buttons, and selector switches
- E. Terminal blocks and accessories
- F. Penetration sealing systems (fire stops)
- G. Electrical/control portion of HVAC work covered by Division 23 pertaining basic electrical materials and methods shall follow the requirement set forth by this specification.

1.2 APPLICABLE CODES AND STANDARDS

- A. NFPA 70, National Electrical Code (latest edition)
- B. American National Standard, National Electrical Safety Code, (latest edition)
- C. Applicable publications of NEMA, ANSI, IEEE, and ICEA
- D. Underwriters Laboratories, Inc. Standards (UL)
- E. Federal, city, state, and local codes and regulations having jurisdiction
- F. OSHA requirements
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. NEMA WD 1 – General-Purpose Wiring Devices
- I. UL 98 - Enclosed Switches

1.3 INTENT

- A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.
- B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. Where applicable, and not in contradiction with the Drawings and specifications, the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.
- C. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request and shall secure the approval of the Engineer before substitution of other material or equipment is purchased. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

1.4 SUBMITTALS

- A. Provide submittals in addition and in accordance with Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

- B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. Damaged materials shall be removed from project site.
- B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

PART 2 - PRODUCTS

2.1 ENCLOSURES AND CABINETS

- A. Enclosures and cabinets for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of the NEMA type as shown in Table 16050-1. Exceptions shall be specifically designated on the Drawings.

Table 16050-1 Enclosures		
Location	Environment	Enclosure Type
Indoor Utility	Dry, subject to dust, falling dirt and dripping non-corrosive liquids	NEMA 12
Indoor	Clean, Dry	NEMA 1
Outdoor	Subject to windblown dust and rain, splashing water, and hose-directed water	NEMA 4
Indoor	Wet, subject to hose-directed water	NEMA 4
Outdoor	Subject to falling rain, sleet, and external ice formation	NEMA 3R
Indoor or Outdoor	Subject to corrosion, windblown dust and rain, splashing water and hose-directed water	NEMA 4X

- B. Enclosures shall have the following properties:
 - 1. Hinged Cover Enclosures: NEMA 250.
 - a. Type 1: Steel.
 - b. Type 4: Steel with gasket door, rain tight.
 - c. Type 4X: Stainless steel, (polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas).
 - d. Type 12: Steel with gasketed door, dust-tight.
- C. Finish: Exterior, manufacturer's standard gray enamel finish; interior, white enamel finish.
- D. Covers: Continuous hinge, held closed by flush latch operable by hasp and staple for padlock. Where required for NEMA ratings, gaskets shall be neoprene rubber.
- E. Interior Panel for Mounting Terminal Blocks or Electrical Components: 14-gauge steel, white enamel finish.
- F. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

- G. Forced Ventilation: Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service. Provide matching exhaust grille assembly. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.2 CONTACTORS

- A. Acceptable Manufacturers
 - 1. General Electric Company
 - 2. Square D Company
 - 3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00.UT and Division 01 for substitution requirement.
- B. Contactors: NEMA ICS 2; electrically held or mechanically held as indicated on Drawings. Two-wire control for electrically held contactors and three-wire control for mechanically held contactors.
- C. Enclosure: NEMA 1 unless indicated otherwise on Drawings.
- D. Control Transformer: Provide when indicated on Drawings. Minimum capacity shall be 100 VA. Provide primary and secondary fuse protection.
- E. Coil operating voltage; 110 volts, 60 Hz or as per drawings.
- F. Size: NEMA ICS 2; size as indicated on Drawings.
- G. Contacts: As indicated on Drawings; 600 Volts, 60 Hz.
- H. Provide solderless pressure wire terminals on bus terminals suitable for mounting in panelboard as indicated on Drawings.

2.3 CONTROL RELAYS

- A. Acceptable Manufacturers
 - 1. General Electric Type CR120A
 - 2. Cutler-Hammer Type M-300
 - 3. Square D Company
 - 4. Allen-Bradley
 - 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00.UT and Division 01 for substitution requirement.
- B. Provide magnetic control relays, NEMA Class A: A300 (300 volts, 10 amps continuous, 7,200 VA make, 720 VA break), industrial control type with field-convertible contacts, and meeting the requirements of NEMA ICS 2.
- C. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a solid-state timer attachment adjustable from 0.2 to 60 seconds (minimum) or with range as indicated. Provide with field convertible from ON delay to OFF delay and vice versa.
- D. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.4 PUSH BUTTONS, AND SELECTOR SWITCHES

- A. Acceptable Manufacturers
 - 1. Allen-Bradley
 - 2. Square D
 - 3. Cutler Hammer
 - 4. Seimens
 - 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00.UT and Division 01 for substitution requirement.

- B. For non-hazardous, indoor, dry locations, including control panels, and individual stations, provide heavy duty, NEMA 13, oil tight type pushbuttons, indicating lights, selector switches, and stations for these devices.
- C. For non hazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, NEMA 4, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4 watertight enclosures. Provide special gasketing required to make complete station watertight.
- D. For hazardous locations, provide control station listed by UL for Class I, Divisions 01 and 02, Groups C and D; Class II, Division 01 and 02, Groups E, F, and G. Specific type shall be in accordance with area classification as indicated on the Drawings.
- E. For corrosive locations, provide nonmetallic components and enclosures meeting NEMA Type 4X.
- F. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide push-button stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in the OFF position wherever lockout provisions are indicated. Nameplates shall be as specified in Section 16195.
- G. Utilize selector switches having standard operating levers. All indicating lights shall be LED type, push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.5 TERMINAL BLOCKS AND ACCESSORIES

- A. Signal And Control Terminals
 - 1. Acceptable Manufacturers
 - a. Phoenix Contact
 - b. Buchanan
 - c. Weidmüller
 - d. Entelec
 - e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 23 00 00 and Division 01 for substitution requirement.
 - 2. Signal and Control Terminals: Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts. Minimum terminal width of 0.24-inch, capable of holding two No. 12 or two No. 14 AWG conductors in each connector. Terminal identification numbers shall be thermoset characters (black) on a white background. Provide 25 percent spare terminals.
- B. Power Terminals
 - 1. Acceptable Manufacturers
 - a. Buchanan
 - b. IlSCO
 - c. Square D Company
 - d. Burndy
 - e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00 and Division 01 for substitution requirement.
 - 2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts, size as required. Provide 25 percent spare terminals.

2.6 PENETRATION SEALING SYSTEMS (FIRE STOPS)

- A. Provide penetration sealing where conduit, cable tray, etc. pass through rated walls, ceilings, and floors. See Section 07840, Fire Stopping, and Section 07900, Joint Sealants, for sealing requirements and systems.

2.7 UL LISTING

- A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

PART 3 - EXECUTION

3.1 FABRICATION - CONTROL ENCLOSURES AND CABINETS

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6.

3.2 INSTALLATION - ENCLOSURES AND CABINETS

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.
- B. Provide accessory feet for freestanding equipment enclosures.
- C. Install trim plumb.

3.3 ERECTION OF EQUIPMENT

- A. Manufacturer's Installation Instructions: Where furnished or called for by the manufacturer equipment manufacturer's installation instructions shall be considered a part of this specification and fully complied with. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.
- B. Mounting Heights: Individual safety switches and buttons and devices shall normally be installed at the following mounting heights, when not specified on the Drawings.
 - 1. Safety Switches: 6 feet 0 inches (to top).
 - 2. Pushbuttons: 4 feet 0 inches (to center).
 - 3. Control Panels: 6 feet 0 inches (to top).
- C. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independently of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

3.4 COORDINATION

- A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer's field representative prior to installation.

END OF SECTION 26 05 00

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SECTION 26 05 19.UT (PREVIOUSLY SECTION 16120) - CABLE, WIRE AND CONNECTORS, 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Building wire.
 - 1. Power distribution circuitry.
 - 2. Control system circuitry.
 - 3. Lighting circuitry.
 - 4. Appliance and equipment circuitry.
 - 5. Motor-branch circuitry.
 - 6. Outdoors lighting and power.
 - 7. Other systems circuitry as designated.
- B. Cable.
- C. Wiring connections and terminations.
- D. Electrical/control portion of HVAC work covered by Division 23 pertaining 600 volt cable, wire and connectors shall follow the requirement set forth by this specification.

1.2 REFERENCES

- A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- C. ANSI/UL 83 – Thermoplastic-Insulated Wire and Cables
- D. NFPA 70 – National Electrical Code, latest edition
- E. NEFA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. Where application of National Electrical Code, trade association standards or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's literature and specification data sheets for each item of cable, wire connectors.
- C. Qualification of cable and wire manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from project site.
- B. Store cable, wire and connectors in a clean, dry indoor space in their factory-furnished coverings, which provides protection against the weather.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Generally, cable, wire and connectors shall be of manufacturer's standard materials, as indicated by published product information.
- B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power or lighting circuits shall be #12 copper with insulation as noted below. Minimum size for control shall be #14 copper.
- C. The conductors of wires and cables shall be of copper (tinned where specified), and have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects.
- D. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 26 05 53.UT, Electrical Identification.
- E. All cable specified for use in tray shall be multiconductor and shall have an outer jacket of flame-retardant, moisture and sunlight resistant polyvinyl chloride (PVC) and shall be UL and NEC approved type for tray installation. Cable installed in cable tray outdoors shall have a jacket that is UV resistant chlorinated polyethylene (CPE) or polyvinyl chloride (PVC), rated 90°C per UL Standard 1277.
- F. All low voltage power and control cable installed in open cable tray above ceilings used for return air shall be plenum rated. Where tray cable is not available in size and type required, conductors shall be installed in conduit.
- G. Use compression lugs for all wiring termination's, except on breakers or terminal strips in panel boards.

2.2 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 5.
- B. Rubber-insulated Building Wire: NEMA WC 3.
- C. Feeders and Branch Circuits Larger Than 10 AWG: 98% conductivity copper, soft-drawn, stranded conductor, 600 volt insulation, THHN/THWN Use XHHW conductors where installed in conduit underground.
- D. Feeders and Branch Circuits 10 AWG and Smaller: 98% conductivity copper, soft-drawn, stranded conductor, 600-volt insulation, THWTHHN/THWN.

2.3 REMOTE CONTROL AND SIGNAL CABLE

- A. 600 Volt Insulation Control Cable for Class 1 Remote Control and Signal Circuits, Type TC:
 - 1. Individual Conductors: 14 AWG, stranded copper, XHHW insulation. Rated 90 degrees C dry, 75 degrees C wet, color-coded per ICEA Method 1 plus one green equipment grounding conductor.
 - 2. Assembly: Bundle wrapped with cable tape and covered with an overall PVC jacket. Cable shall pass IEEE-1202 vertical tray ribbon-burner flame test (210,000 BTU) VW-1.
- B. Instrumentation Cable
 - 1. 300 Volt Instrumentation Cable, Multiple Pairs, Overall Shield, Type PLTC:
 - a. Individual Conductors: 18 AWG, stranded, tinned copper, flame retardant polyethylene or PVC insulated, rated 105 degrees C, black and white numerically printed and coded pairs.

- b. Assembly: Individual twisted pairs having a 100 percent coverage aluminum-polyester shield and 20 AWG stranded tinned copper drain wire. Conductor bundle shall be shielded with 100 percent coverage overall aluminum-polyester shield complete with 20 AWG drain wire. All group shields completely isolated from each other. Bundle wrapped with cable tape and covered with an overall flame retardant PVC jacket. Cable shall pass IEEE-383 vertical tray flame test (70,000 BTU) UL1581.

C. Life Safety Systems Cable

- 1. All life safety system wiring shall be installed in dedicated conduit or raceway with adequate separation/shielding from all other systems.
- 2. Life safety systems wiring shall be as specified in the Section 28 31 00.UT - Fire Alarm and Smoke Detection Systems.

D. Security/Access Control/CCTV Cable

- 1. All security/access control wiring shall be installed in dedicated conduits.
- 2. Security/access control wiring shall be rated and as specified below:

Circuit Type	No. of Conductors	Conductor Specifications	Cable Specifications
20 mA Current Loop	2	18-gauge, stranded copper	2 cables, 1 twisted pair each required
Card Reader Coaxial	--	18-gauge, solid copper, center conductor	Schlage Model No. SE9284PL or Anicom 5910PL
Contact Circuits	2	18-gauge, stranded copper	Nonshielded, twisted
CCTV Coaxial	--	--	Belden 89259 plenum rated, or approved equal

- 3. All security/access control power circuit wiring shall comply with paragraph 2.2. Building Wire of this Section.

- E. Plenum Cable for Class 3 Remote Control and Signal Circuits: 98% conductivity copper conductor, 300 volt insulation, rated 60 degree C, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following types, classes, kinds and styles.

- 1. Type:
 - a. Solderless pressure connectors
 - b. Crimp.
 - c. Threaded.
 - d. Insulated spring wire connectors with plastic caps for 10 AWG and smaller.
- 2. Class: Insulated.
- 3. Material: Copper (for CU to CU connection).
- 4. Style:
 - a. Insulated terminals. Use ring-terminal for control wiring. Use flange (fork) spade compression terminal for termination of stranded conductors at wiring devices, including ground connection.
 - b. Split bolt-parallel connector.
 - c. Pigtail connector.
 - d. Pre-insulated multi-tap connector.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 GENERAL WIRING METHODS

- A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.
- B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Do not install the conductors until raceway system is complete and properly cleaned.
- C. Cables shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN and THHN in building interiors and other dry locations. Outdoors and underground in raceways, use Type RHW. Conductors subject to abrasion, such as in lighting poles, shall be Type THWN or THHN.
- D. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 50' in length (100' for 277 volt) no conductor smaller than a No. 10 wire shall be used. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions. Separate neutral conductors shall be provided for each phase of the same size for 120V/277V single-phase application for heavy electrical loads, computer loads, loads fed from isolated transformers, lab equipment, clinic equipment, dedicated circuits, unless noted otherwise on drawings. Voltage drop on feeders and branch circuits shall not exceed NEC requirement.
- E. Remote control wires shall be no smaller than No. 14 conductors. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. The Contractor may, if he deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.
- F. Install exposed wire and cable, parallel and perpendicular to surface or exposed structural members and follow the surface contours, where possible.
- G. Splice branch circuits only in accessible junction or outlet boxes. Control cable shall never be spliced except the final connection to field devices. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.
- H. Wiring Within An Enclosure: Contractor shall bundle ac and dc wiring separately within an enclosure. The Contractor shall utilize panel wire-ways when they are provided. Where wireways are not provided the Contractor shall neatly tag, bundle wires and secure to sub-panel at a minimum of every three inches with T&B Type TC5355 heavy duty mounting bases.
- I. Do not band any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

3.3 WIRING INSTALLATION IN RACEWAYS

- A. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer's recommended values for maximum pulling tension.

- B. Pull conductors together where more than one is being installed in a raceway.
- C. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.
- D. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.
- E. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- F. Place an equal number of conductors for each phase of a circuit in same raceway.
- G. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.
- H. All conduits shall contain a green grounding conductor. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

3.4 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage during construction. Do not install cable before the completion of raceway system.
- B. Cable above ceilings shall be in conduit or raceways. Cables, conduits and raceways shall not be laid on ceiling tiles or strapped to ceiling wire.
- C. Use suitable cable fittings and connectors.
- D. It shall be the Contractor's responsibility to accurately measure all cable runs before the cable is cut. The Contractor shall furnish all tools and equipment, have sufficient properly trained personnel and shall exercise necessary care to ensure that the cable is not damaged during installation. Cable found to be damaged before installation shall not be installed. Cable damage during installation shall be removed and replaced. Repairs to cables can only be done with written permission from the Owner's Representative and only under special circumstances.
- E. Care shall be exercised with cables entering or leaving cable trays that all cable bend radii shall not be less than the recommended minimum and that cables are not left to rest unprotected on any sharp edge or corner.
- F. PVC jacketed cable shall not be installed or worked in any way at temperatures below 32 degrees F, unless cable has been previously stored in a heated area 48 hours prior to being pulled and transported to a heated pulling area.
- G. Each cable entering an enclosure shall have its conductors bundled together and identified with the cable number. All groups of conductors within an enclosure shall be shaped and formed to provide a neat appearance to facilitate future additions or rework. All control conductors shall be numbered and shall be labeled at each termination with this number, using markers designed for the application.
- H. Multi-Conductor Cable Installation: Power and 120V control cable shall be installed in the same tray. When cables leave trays, they shall be protected between the trays and the cable terminal points by drawing them through conduits. Do not route 600V cables (power cable and 120V control cable) in the same conduit or cable tray as low voltage cables (less than 50V, communications, security systems, or control conductors). Do not route security systems, or control cables through communications rooms. Fire alarm cable shall be routed in a separate conduit only.
- I. Instrument Cable: Instrument cable shall, when conduit installation is required be installed in rigid steel conduit. They shall not be spliced at any point. The shields and drain wires of shielded signal cables shall be grounded only at one point as indicated on the Drawings.

3.5 WIRING CONNECTIONS AND TERMINATIONS

- A. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

- B. Keep conductor splices and taps accessible and to a minimum, and in junction boxes only. Control circuit conductors shall terminate at terminal blocks only. Splices below grade shall only be in handholes or manholes and shall be made watertight with epoxy resin type splicing kits similar to Scotchcast.
- C. Use splice, tap and termination connectors, which are compatible with the conductor material.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. Terminate spare conductors with electrical tape and label as spare.
- F. Power and Lighting Circuits: Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.
- G. Use split bolt connectors for copper wire splices and taps, 6 AWG and larger. Tape un-insulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- H. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.
- I. Identify conductors per Section 26 05 53.UT - Electrical Identification.

3.6 FIELD QUALITY CONTROL

- A. Torque test conductor connections and terminations to manufacturer's recommended values.
- B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.
- D. Conductors may be run in parallel on sizes 1/0 to 500 MCM inclusive provided all paralleled conductors are the same size, length, and type of insulation. Except as otherwise shown on drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.

3.7 TESTING AND ACCEPTANCE

- A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.
- B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.
- C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

END OF SECTION 26 05 19

SECTION 26 05 26.UT (PREVIOUSLY SECTION 16450) - GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Power system grounding.
- B. Communication system grounding.
- C. Electrical equipment and raceway grounding and bonding.

1.2 RELATED WORK

- A. Lightning protection.

1.3 REFERENCES

- A. NFPA 70 – National Electrical Code, latest edition
- B. ANSI/UL 467 – Electrical Grounding and Bonding Equipment
- C. ANSI/IEEE STD 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
- D. IEEE 81 – Guide for Measuring Earth Receptivity, Ground Impedance and earth Surface Potential of a ground System
- E. IEEE 1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- F. ANSI/TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications

1.4 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to grounding electrodes. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operations. Concrete encased electrodes shall be connected as the most effective grounding electrodes. Provide a completely grounded system in accordance with Article 250 of the NEC.
- B. Ground each separately-derived system neutral to separate ground buses that are installed in nearest electrical rooms. Transformer, UPS systems, power conditioners, inverters, or other power supplies are separately derived systems. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.
- C. Provide communications system grounding conductor connected to separate electrode (ground bus) that is installed in each IT room.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath, ground bus in electrical rooms and IT rooms, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metal underground water pipe.
- E. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

- F. Supplementary Grounding Electrode: [Use driven ground rod [on exterior of building.] [in main service equipment area.]] [Install ground rod in suitable recessed well; fill with gravel after connection is made.] [Use effectively grounded metal frame of the building.] [Use minimum of 20 feet No. 4 bare copper wire embedded in concrete foundation.]
- G. Use minimum 6 AWG copper conductors for communications service grounding conductor. Leave 10 feet slack conductor at termination [board.] [cabinet.]

1.5 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.
- B. Ground conductors shall be stranded tinned, annealed copper cable of the sizes indicated on drawings. Bond grounding conductors at both ends of metallic conduit.
- C. Grounding clips shall be Steel City Type G, or equal.
- D. Ground Rods shall be copper-encased steel, 3/4" diameter, minimum length 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install ground system as indicated, in accordance with the applicable requirements of the National Electrical Code and the National Electrical Contractors Association's "Standard of Installation".
- B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. Install test wells as required per drawings.
- C. In feeder and branch circuits, provide a separate, insulated equipment grounding conductor. Terminate each end on a grounding lug, bus, or bushing.
- D. Connect grounding electrode conductors to metal water pipe where metal pipe is available and accessible using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- E. Install fusion welded ground connectors where they are concealed or inaccessible.
- F. Ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the cover plate; or by the use of an approved grounding yoke type receptacle.
- G. No strap grounding clamps shall be used; connections requiring bolting shall be made up with monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.
- H. Install external ground wire on liquid tight flexible metal conduit with grounding bushings.
- I. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors. .
- J. The neutral of each transformer shall be bonded to system ground at one point only. This point shall be ahead of the first secondary protective device.

- K. Connect grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection points below finished grade. Below grade connection shall be exothermic-welded type connectors as manufactured by Cadweld, Thermoweld. In manhole, install ground rods with 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.
- L. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to separate grounding bus.
- M. Provide grounding and bonding at Utility Company's metering equipment and pad-mounted transformer in accordance with Utility Company's requirements.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 10 ohms. Provide additional ground rod as required until resistance reading is 10 ohms or less.

END OF SECTION 26 05 26

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SECTION 26 05 29.UT (PREVIOUSLY SECTION 16190) - SECURING AND SUPPORTING METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Raceway, cable tray, and equipment supports
- B. Fastening hardware
- C. Coordinate location of concrete equipment pads

1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads

1.3 COORDINATION

- A. Coordinate with other trades where conduit and cable tray supports are in the same location as piping, ductwork, and work of other trades and where supports are furnished and installed under other Divisions. Supporting from the work or supports of other Contractors shall not be allowed except by express, written permission of the Owner.

1.4 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Support Channel:
 - 1. All non-corrosive locations: Hot-dip galvanized steel.
 - 2. Corrosive locations: Nonmetallic fiberglass.
- B. Hardware:
 - 1. All non-corrosive locations: Hot-dip galvanized steel.
 - 2. Corrosive locations: Stainless steel threaded rod, attachments and fasteners shall be used with fiberglass supports.
- C. Threaded Rod: used for rack support from structure above; 3/8-inch minimum diameter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Provide necessary calculations to select proper support materials for electrical equipment, raceway, and cable tray supports. Provide cable tray supports for cable tray filled to 125 percent capacity per NEC.
- B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

- D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
 - E. Do not use powder actuated anchors without written permission from the Engineer.
 - F. Do not drill structural steel members without written permission from the Structural Engineer.
 - G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
 - H. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.
 - I. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inches off wall. Utilize "Post Bases" where support channel is attached to structural floor.
 - J. Provide extra care in supporting PVC conduit to protect it from potential damage.
 - K. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.
 - L. All supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.
 - M. Conduit supports shall have at a minimum, the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut.
 - N. Conduit entering/exiting cable tray shall be attached to the tray rail by means of unistrut bolted to the rail and standard manufacturer's accessories. Conduit shall only enter/exit tray horizontally supported within three feet of the tray, and extended into the tray two inches. Conduit shall be terminated with a grounding bushing, and bonded to the tray ground wire. (The attachment to the tray shall not be considered a support.)
 - O. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
 - P. Install freestanding electrical equipment on 4-inch concrete pads. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads. Equipment includes but not limited to the following:
 - 1. Motor Control Centers
 - 2. Static Transfer Switches
 - 3. Floor mounted VFDs
 - 4. Floor mounted transformers
 - 5. Switchboards, 1200A and larger
 - Q. Do not anchor supports to columns. Where panelboards, cables, or conduits are routed on the face of a column provide "column hugging" channel supports.
- 3.2 TOUCH-UP
- A. Touch-up all scratches on securing and supporting system, and paint the ends of channel after cutting with an approved zinc chromate or 90 percent zinc paint.

END OF SECTION 26 05 29

SECTION 26 05 33.UT (PREVIOUSLY SECTION 16110) - RACEWAYS, CONDUITS AND BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Raceways:
 - 1. Surface metal raceways.
 - 2. Multi-outlet assemblies.
 - 3. Wireways.
 - 4. Indoor service poles.
- B. Conduit:
 - 1. Rigid metal conduit and fittings. (RGS)
 - 2. Intermediate metal conduit and fittings. (IMC)
 - 3. Electrical metallic tubing and fittings. (EMT)
 - 4. Flexible metal conduit and fittings.
 - 5. Liquid-tight flexible metal conduit and fittings.
 - 6. Non-metallic conduit and fittings. (underground use only)
 - 7. PVC coated rigid steel conduit.
- C. Boxes:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.
- D. Electrical/control portion of HVAC work covered by Division 23 pertaining raceway, conduit and boxes shall follow the requirement set forth by this specification.

1.2 REFERENCES

- A. NFPA 70 – National Electrical Code, latest edition
- B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
- C. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated
- D. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies
- E. EMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- F. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. ANSI/NEMA TC 2 – Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- I. ANSI/UL 1 – Flexible Metal Conduit
- J. ANSI/UL 5 – Surface Metal Raceways and Fittings
- K. ANSI/UL 360 – Liquid-tight Flexible Steel Conduit
- L. ANSI/UL 467 – Electrical Grounding and Bonding Equipment
- M. ANSI/UL 651 – Schedule 40 and 80 Rigid PVC Conduit (underground use only)
- N. ANSI/UL 797 – Electrical Metal Tubing
- O. ANSI/UL 870 – Wireways, Auxiliary Gutters and Fittings
- P. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- Q. NEMA VE 1 – Metallic Cable Tray Systems
- R. UL 6 – Rigid Metal Conduit
- S. ANSI/UL 5C – Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

- T. ANSI/UL 498 – Attachment Plugs and Receptacles
- U. ANSI/UL 943 – Ground Fault Circuit Interrupters

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00.UT, Basic Electrical Requirements, and Section 01330, Submittal Procedures.
- B. Shop drawings consisting of a complete list of equipment and materials, which will be used for the project, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions.
- C. Sealing/fire stopping materials and details.

1.4 STORAGE AND HANDLING

- A. Handle materials carefully to avoid damage, breaking, denting and scoring. Damaged equipment or materials shall not be installed.
- B. Store materials in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

- A. Surface metal raceway shall be factory pre-assembled galvanized steel complete including bases, removable covers, receptacles, end plates, elbows, connectors and fittings, to exact length to match the length of the cabinets, casework, utility chases, and shelving as indicated on laboratory and furniture shop drawings, and work bench details, as applicable.
- B. Size shall be as shown on the Drawings. The length shown on electrical drawings is diagrammatic only and is not accurate for fabrication of raceway Sections. Refer to shop drawings, architectural plans, elevations, and details.
- C. Finish shall be ANSI-61 gray enamel .
- D. Covers shall be field removable by use of a standard screwdriver, without marring the extrusion or cover finish. Raceway with two covers must allow each cover to be removed separately without access into the compartment(s) enclosed by the other cover.
- E. Provide a permanent, integral, grounded metallic dividing barrier to isolate the wiring compartments in the multi-outlet raceway system per drawing as applicable. Provide divider with fittings that maintain the separation of the raceway wiring compartments.
- F. Provide device brackets for mounting standard single-gang or two-gang devices within the raceway system. Devices shall have the capacity of mounting flush or in conjunction with device faceplates.
- G. Provide receptacles for the respective power systems as indicated on the drawings. Refer to Section 26 27 26.UT Wiring Devices for device specifications.

2.2 MULTI-OUTLET ASSEMBLY

- A. Multi-outlet assembly shall be two-piece sheet metal channel with fitted, removable cover suitable for use as a multi-outlet assembly.
- B. Size shall be as indicated on the Drawings.
- C. Provide receptacles mounted as shown on Drawings.
- D. Finish shall be ANSI-61 gray enamel.
- E. Provide couplings, elbows, outlet and device boxes, and connectors designed for use with multi-outlet system.

2.3 WIREWAYS

- A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.
- B. Size shall be as indicated on Drawings.
- C. Cover shall be hinged or screw applied as indicated on Drawings. Rain tight wireways shall be provided with full gasketing.
- D. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.
- E. Provide all sheet metal parts with a rust inhibiting phosphating primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

2.4 CONDUIT AND FITTINGS

- A. Conduit and fittings for all electrical systems on this project shall include the following:
 - 1. Service entrance
 - 2. Electrical power and lighting feeders
 - 3. Electrical power and lighting circuits
 - 4. Telephone systems
 - 5. Control systems (other than HVAC)
 - 6. Fire alarm and signaling systems
 - 7. CCTV rough-in system
 - 8. Clock and bell system
 - 9. Computer system rough-in
 - 10. Sound system rough-in
 - 11. Other electrical systems
- B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by N.E.C. Article 250. Grounding bushings shall have insulated throats.
- D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type. Expansion fittings shall be OZ Type DX.
- E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression type. Expansion fittings shall be OZ Type TX.
- F. Flexible metal conduit and fittings shall be zinc-coated steel.
- G. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC). It shall be furnished with a sealing O-ring where entering an enclosure subject to moisture. Where O-Rings are used, ground type bushings shall be used in the box or enclosure.
- H. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C. Nonmetallic conduit and fittings shall be molded of high impact PVC compound having noncombustible, nonmagnetic, non-corrosive and chemical resistant properties and shall be of the same manufacturer. Where located outdoors and above ground, the conduit and fittings shall be UV resistant. Solvent cement shall be of the same manufacturer as the conduit and shall be of the brush-on type. Spray solvents are prohibited. PVC coated metallic fittings shall not be permitted for PVC conduit connections.
- I. Crimp or set-screw type fittings are not acceptable.

- J. Minimum conduit size shall be 3/4 inch, except 1/2 inch flexible metallic conduit may be used as fixture whips.
- K. PVC coated rigid steel conduit shall be externally coated with a 40 mil PVC coating and internal phenolic coating over a galvanized surface.

2.5 WALL AND CEILING OUTLET BOXES

- A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
 - 1. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
 - 2. Provide multi-gang outlets of single box design. Sectional boxes are not acceptable. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NEC, and not less than 1 ½ inch deep unless shallower boxes are required by structural conditions and are approved by the A/E.
- B. Provide deep type cast metal weatherproof exterior outlet wiring boxes of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket and fasteners. Provide PVC type outlet boxes only in corrosive areas rated as NEMA 13X.
- C. Outlet boxes in poured concrete shall be plenum type without any holes and with reset knockouts. Where extension rings are used to offset conduit between wall reinforcing steel, joint between extension ring and box shall be sealed to prevent concrete from entering box during pour.
- D. Provide 4-inch octagonal ceiling outlet boxes.

2.6 PULL AND JUNCTION BOXES

- A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.
- B. Boxes larger than 12 inches in any dimension shall be panelboard code gauge galvanized steel with hinged cover.
- C. Boxes shall be sized in accordance with NEC.
- D. Provide cast-in-place, pre-cast concrete or die-molded fiberglass handholes/pull boxes as per design for underground installations. Cast-in-place and pre-cast boxes shall be provided with reinforcing bars with material compressive strength no less than 11,000 psi, and shall be approved by Owner/Structural Engineer.

2.7 CABLE TRAY AND FITTINGS

- A. Ladder type cable trays
 - 1. Tray: NEMA VE 1, Class 12C or as indicated on the drawings.
 - 2. Material and Finish of Tray, Fittings, and Accessories: 6063-T6 aluminum extrusion or hot-dip galvanized after fabrication steel (ASTM A123) as indicated on Drawings.
 - 3. Inside width: 12 inches minimum or as indicated on Drawings.
 - 4. Inside depth: 4 inches minimum or as indicated on Drawings
 - 5. Straight Section rung spacing: 12 inches on center.
 - 6. Inside radii of fittings: as indicated on Drawings
 - 7. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
 - 8. Provide covers on tray where exiting the top of control cabinets, communication/data cabinets, distribution panelboards and switchboards which covers vertical Sections of tray and 90 degree bend.
- B. Perforated bottom cable trays

1. Tray: NEMA VE 1, Class 12C.
 2. Material and Finish of Tray, Fittings, and Accessories: 6063-T6 aluminum extrusion or hot-dip galvanized steel (ASTM A123).
 3. Inside Width: 12 inches minimum or as indicated on Drawings.
 4. Inside depth: 4 inches or as indicated on Drawings.
 5. Inside radii of fittings: 12 inches.
 6. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
 7. Utilization: Data cables, control cables, telephone cables, fiber optics. Do not use for vertical sections. Vertical cables shall be installed vertical floor mounted racks.
 8. Covers: Ventilated covers where indicated on the drawings.
- C. Fiberglass cable trays
1. Tray: NEMA FG1
 2. Material and finish of tray, fittings, and accessories: Glass fiber reinforced polyester.
 3. Inside width: 12 inches minimum or as indicated on Drawings.
 4. Inside depth: 4 inches minimum or as indicated on Drawings.
 5. Inside Radii of Fittings: 12 inches or as indicated on Drawings.
 6. Accessories and Fittings: Manufacturer's standard clamps hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, and connectors.
 7. Covers: Solid covers where indicated on the drawings.
- D. Warning signs for cable trays
1. 1/2-inch high black letters on yellow plastic with the following wording: **WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!**

PART 3 - EXECUTION

3.1 INSTALLATION - CONDUIT

- A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".
- B. Cut conduit square using a saw or pipe cutter. De-burr cut ends. Joints in steel conduit must be painted with T&B Kopr shield and drawn up tight. Threads for rigid metal conduit and IMC shall be deep and clean. Running threads shall not be used. Wipe plastic conduit clean and dry before joining. Apply full, even coat of cement with brush to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum. Spray type of cement is not acceptable. Install raceway and conduit system from point of origin in outlets shown, complete with support assemblies including all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, clips angles, through bolts, brackets, saddles, nuts, bolts, washers, offsets, pull boxes, junction boxes and fittings to ensure a complete functional raceway system. Where vertical drops of conduit are made to equipment in open space, the vertical conduit shall be rigidly supported from racks supported on the floor.
- C. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit for service entrance; feeders; wall or floor penetrations; mechanical rooms electrical rooms and exposed locations where there is a high potential subject to physical damage; exposed outdoor locations; damp locations or any location as per design drawing. The following exceptions permitted:
 1. EMT
 - a. In sizes up to and including 1-1/2 inch, may be used inside dry locations where not subject to mechanical damage. EMT may be used in air-conditioned spaces, such as accessible ceilings, dry wall partitions and exposed where 6 feet above the floor. EMT may not be used outside, in concrete, underground, in under floor spaces, in masonry walls, in locations likely to be damp, in electrical rooms subject to mechanical damage due to future installation, or exposed within 6 feet of the floor. EMT shall not be used for medium voltage circuits.
 - b. Where used for feeder circuits receptacle branch circuits and motor branch circuits EMT shall also contain a NEC grounding conductor.

- c. All conduits shall be concealed in walls or ceilings unless otherwise noted.
 2. PVC (underground use only)
 - a. Install PVC schedule 40 conduit where direct buried in earth.
 - b. Type EB, Utility Duct, encased in concrete.
 3. Liquid-tight
 - a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including dry-type transformers. Install external ground wire on flexible conduit with grounding bushings. Maximum length shall be 6 feet minimum of 2 feet.
 4. Flexible Metal Conduit
 - a. Install standard flexible metal conduit (not liquid-tight), which shall be only used for lighting fixture whips or motor vibrations, with internal ground wire. Install flexible conduit connection such that vibrations are not transmitted to adjoining conduit or building structure. Maximum length shall be 6 feet minimum of 3 feet; minimum size shall be 3/4; and minimum size shall be 1/2 inch for lay-in light fixture whips.
- D. Install conduits parallel and supported on Unistrut, or equal, trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. No raceways or boxes shall be supported using wire. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route exposed conduit and tray above accessible ceilings parallel and perpendicular to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues, steam pipes, and heating appliances. Wire ties or "wrap lock" are not permitted to support or secure conduit system. Fasten conduit with the following material:
 1. Wood screws on wood
 2. Toggle bolts on hollow masonry
 3. Bolts and expansion anchors in concrete or brick
 4. Machine screws, threaded rods and clamps on steel
 5. Conduit clips on steel joists.
 6. 4 inch x 4 inch penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5 feet.
- E. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground. Encase all plastic service entrance conduits with concrete unless otherwise specifically detailed or noted on the drawings.
- F. Ducts in concrete encased ductbanks shall be independently supported by interlocking module spacers by Formex or equal. Spacers shall provide 3 inches separation between adjacent ducts. Spacers shall be installed at 6 feet maximum intervals.
- G. Ducts in concrete encased ductbanks shall be terminated in manholes, pull boxes, and vaults with interlocking terminators . A watertight tapered plug shall be furnished and installed in unused duct openings. Where terminators are installed in new work, they shall be poured-in-place.
- H. Install underground conduits with sealing glands equal to OZ Type FSK exterior to the conduit and OZ type CSB, or equal internally at the point where conduits enter the building to prevent water seepage into the building.
- I. Fittings shall be approved for grounding purposes or shall be jumpered with a copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.
- J. Install expansion fittings in metal and PVC conduit as follows:
 1. Conduit Crossing Building Expansion Joints:
 - a. EMT all sizes
 - b. IMC all sizes
 - c. RMC all sizes
 - d. PVC all sizes
 2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.

3. Unless expansion fitting has an integral bonding braid, as in Crouse-Hinds Type XC, a green insulated grounding conductor shall be pulled in the conduit. Both ends of this green grounding conductors shall be accessible for inspection.
 - K. Install conduit concealed in walls, partitions and above ceilings. Install conduit exposed in ceiling area (at structure) of boiler rooms, mechanical rooms and in other similar rooms where ceilings are not called for. Install conduit concealed in slab when finished areas below do not have ceiling. A written approval shall be obtained from Owner/Structural Engineer prior to construction.
 - L. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
 - M. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture if cable or wire are not installed immediate after conduit run. Tape covering conduit ends is not acceptable.
 - N. Provide 200 lb. nylon cord full length in empty conduit.
 - O. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with oakum and fill ends of sleeve with fire-resistive compound or provide mechanical fire-stop fittings with UL listed fire-rating or seal opening around conduit with UL listed foamed silicone elastomer compound equal to fire-rating of floor or wall.
 - P. Install no more than the equivalent of three 90-degree bends between boxes. Where four 90 degree bends are required, prior approval by the Engineer is required. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bodies shall be readily accessible and sized for the cables installed. Running or rolling offsets are not approved. Use factory long radius elbows for bends in conduit larger than 2-inch size. All parallel bends shall be concentric.
 - Q. Conduit entering / exiting cable tray shall be attached to the tray rail by means of strut bolted to the rail and standard manufacturer's accessories or by use of a UL listed conduit to tray connector. Conduit shall only enter / exit tray horizontally supported within 3 feet of the tray and extend into the tray 2 inches. Conduit shall be terminated with a grounding bushing and bonded to the ground conductor routed in the tray. (The attachment to the tray shall not be considered a ground.)
 - R. Pull string shall be provided full length in conduit designated for future use.
- 3.2 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET
- A. Use flathead screws to fasten channel to surfaces. Mount plumb and level.
 - B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings on multi-outlet assembly.
 - C. Maintain grounding continuity between raceway components to provide a continuous grounding path in accordance with the requirement of NEC.
- 3.3 INSTALLATION - WIREWAYS
- A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure.] Install level.
 - B. Gasket each joint in oil-tight wireway.
 - C. Mount rain tight wireway for exterior installation in horizontal position only.
- 3.4 INSTALLATION - BOXES
- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
 - B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
 - C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in.

- D. Locate and install boxes to allow access, minimum 12 inches above ceiling except where space dimensions do not allow.
- E. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic-rated walls. If boxes are connected together, install flexible connection between the two and pack openings with fiberglass.
- F. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Do not support junction boxes from the raceway systems. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. Boxes connected to one stud are not permitted.
- G. Provide knockout plugs for unused openings.
- H. Use multiple-gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- I. Install boxes in walls without damaging wall insulation.
- J. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.
- K. Outlet boxes for switch shall not be used as junction boxes.
- L. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- M. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- N. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.
- O. Set floor boxes level and flush with finish flooring material.
- P. Provide tamper resistance receptacles in child care areas, psychiatric, and medical facilities.

3.5 INSTALLATION – CABLE TRAY

- A. Installation: In conformance with NEC and NEMA requirements and in accordance with manufacturer's instructions. Arrange cable tray to maintain headroom and present neat appearance. Cables shall be arranged in cable trays in a neat, workmanlike manner.
- B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 feet maximum. Trays shall be level with respect to grade plus or minus 1/8-inch per 10 feet or 1/2-inch cumulative. Unless otherwise noted cable trays shall be supported by rigid steel brackets or trapeze type hangers. Hanger materials, including threaded hanger rods, all brackets, and other structural support items shall be per 16190, Supporting Methods and shall have sufficient strength to support the load with a safety factor of at least 3 when all trays are filled to design capacity. Where multiple tiers of cable tray are installed, a minimum of 100-lbs./foot fill for each cable tray shall be used to establish support requirements if limiting factor is the supporting material. In fabricating or installing cable tray supports, holes shall be drilled and cuts made with a saw. Hanger rods shall be of 1/2-inch or larger diameter, shall be double-nutted at the lowest cable tray support and the hanger rod shall be cut off one (1) inch below the bottom nut. Cable tray support spacing shall not exceed 10 feet for ladder type trays. Hanger rods shall be unspliced. Cable trays installed on trapeze type hangers shall be braced laterally at intervals not exceeding 50 feet. Refer to Section 26 05 29 for cable tray support methods.
- C. Where it is necessary to make field changes in the tray system, cuts shall be made with hacksaw or power saw. All sharp edges and burrs shall be removed.
- D. Install warning signs at 50 foot centers along route of cable tray, in locations visible from the floor.

- E. Where new cable trays are installed above, below or in-line with existing cable trays, the new cable tray shall be supported independently from the existing cable tray with new supports and framing unless approved by the Owner and the Structural Engineer. Maintain twelve-inch clearance between cable tray and surfaces with temperatures exceeding 104 degrees F, such as flues, steam pipes, and heating appliances. Maintain at least 6-inch clearance between cable tray and piping, ductwork or other interference. Any deviation from this must be approved by the Owner. It shall be the Contractor's responsibility to protect existing cable tray in the area of construction against damage throughout the construction period. Any damaged cable tray shall be replaced by the Contractor at no additional cost prior to final acceptance by the Owner.
- F. All power cable trays shall have a continuous; No. 4/0 insulated copper, (for aluminum tray) and bare copper (for galvanized steel tray) grounding conductor run inside the tray. Bond No. 4/0 to each section of tray and fitting with an OZ Gedney type CTGC ground clamp. All communication cable trays shall have a continuous, No. 6, green insulated copper grounding conductor run inside the tray. Connect to tray at each fitting or tray section per the Drawings.
- G. Maintain electrical continuity between sections of cable tray and bond cable trays at the both ends to building ground plates to provide a continuous grounding path. Install copper braided bonding jumpers around expansion joints and hinged adjustable splice plates where electrical discontinuity occurs.
- H. Cable tray in designated "Corrosive" areas shall be fiberglass.

3.6 INSTALLATION - INDOOR SERVICE POLES

- A. Verify that installation of ceiling suspension system and other work above finished ceiling is complete.
- B. Neatly cut openings in ceiling panels.
- C. Attach foot and top clamp in accordance with manufacturer's instructions.
- D. Install trim plate to enclose ceiling panel opening.
- E. Install poles plumb. Install grounding.

3.7 WALL AND FLOOR PENETRATIONS:

- A. Core drilling shall be approved in writing by the Structural Engineer prior to execution. Avoid anchor bolt on structural column by installing "column hugging" type of unistrut support for electrical installation. PVC shall not be used for wall and floor penetration.
- B. Wall penetrations for cable tray or under floor raceway shall be sealed in accordance with Specification Section 07840, Fire-stopping and Section 07900, Joint Sealers.
- C. Provide a 3 1/2 inch curb around block outs through concrete floors. Fire-stop per Architectural specification.
- D. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate roof penetrations with the roofing contractor.

END OF SECTION 26 05 33

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SECTION 26 05 53.UT (PREVIOUSLY SECTION 16195) - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Nameplates and tape labels
- B. Wire and cable markers
- C. Conduit color coding and labeling

1.2 REFERENCES

- A. NFPA 70 – National Electrical Code (latest edition)

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.
 - 1. Furnish nameplate identification schedules listing equipment type and nameplate data with letter sizes and nameplate material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Equipment Nameplates:
 - 1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.
 - 2. For emergency equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on a red background.
 - 3. For UPS powered equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on an orange background.
 - 4. For fire alarm system provide engraved three-layer laminated plastic nameplates with white letters on a yellow background.
 - 5. For security and CCTV system panels, provide engraved three-layer laminated plastic nameplates with white letters on a blue background.
- B. Underground Warning Tape
 - 1. Manufactured polyethylene material and unaffected by acids and alkalines.
 - 2. 3.5 mils thick and 6 inches wide.
 - 3. Tensile strength of 1,750 psi lengthwise.
 - 4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background.
- C. Conductor Color Tape and Heat Shrink:
 - 1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.
 - 2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of wire or cables are not acceptable.
- D. Conduit Labels (5 kV and 15 kV Conduits Only): 2-inch black letters on yellow background reading "DANGER - 12,470 VOLTS" or "DANGER - 4,160 VOLTS". Labels shall have adhesive backing, and shall be installed at intervals not exceeding 50 feet and on all pull boxes located to be visible from floor.
- E. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2" lettering.

- F. Tape Labels: Embossed adhesive tape, with minimum 1/4-inch letters for labeling receptacles, switches, control device stations, junction and pull boxes and manual motor starter units, etc.
 - 1. White letters on black background for normal power.
 - 2. White letters on red background for emergency/standby power.
 - 3. White letters on orange background for UPS power.
- G. J-Box and Cover plate Voltage Labels: Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates or tape labels.
- B. Install nameplates parallel to equipment lines.
- C. Secure plastic nameplates to equipment fronts using screws or rivets. Use of adhesives shall be per Owner's approval. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits. Label control wire with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. Conductors for power circuits to be identified per the following schedule.

Conductor	System Voltage			
	480/277V	208/120V	240/120V High Leg	Medium Voltage
Phase A	Brown	Black	Black	One White Band
Phase B	Purple	Red	Orange	Two White Bands
Phase C	Yellow	Blue	Blue	Three White Bands
Neutral	Gray	White	White	N/A
Grounding IG	Green N/A	Green Green w/Yellow	Green Green w/Yellow	Green N/A

3.3 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.
- B. Individual Circuit Breakers in Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4-inch; identify source to device and the load it serves, including location.
- C. Dry Type Transformers Not in Substations: 3/8-inch; identify equipment designation. 1/4-inch; identify primary and secondary voltages, primary source, and secondary load and location.
- D. Automatic Transfer Switches: 3/8-inch; white letters and red background; identify equipment designation 1/4-inch; identify voltage rating, normal source, standby source and load served including location.
- E. Panelboards: 3/8-inch; identify equipment designation. 1/4 -inch; identify source, voltage and bus rating.

3.4 ENCLOSURE COLOR CODING

- A. The following systems shall have each junction and pull box cover completely painted per the following:

System	Color of Box Cover
Ethernet Backbone	Blue
Telecommunications	Brown
FCMS	Green
Emergency Power	Red
Security**	White
Fire Alarm	Yellow
Clock	Fluorescent Violet
U.P.S.	Fluorescent Pink

**Security shall include, but not be limited to, the following systems:

- Card Access
- Duress Alarms
- Perimeter Door Alarms
- CCTV

END OF SECTION 26 05 53

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SECTION 26 27 26.UT (PREVIOUSLY SECTION 16140) - WIRING DEVICES AND FLOOR BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Wiring Devices:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Device plates and box covers.
 - 4. Wall dimmers.
 - 5. Occupant sensors.
- B. Floor boxes.
- C. Wiring for HVAC in Division 23 shall meet the requirement of this specification.

1.2 REFERENCES

- A. Americans with Disabilities Act (ADA)
- B. ANSI/NEMA OS 1- Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. ANSI/UL 20 – General Use Snap Switches.
- D. ANSI/UL 498 – Attachment Plugs and Receptacles.
- E. ANSI/UL 943 – Ground Fault Circuit Interrupters.
- F. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts maximum).
- G. NEMA WD 1 – General-Purpose Wiring Devices.
- H. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.
- I. NEMA WD 5 - Specific-Purpose Wiring Devices.
- J. Texas Accessibility Standards. (TAS)

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver wiring devices individually wrapped in factory-fabricated containers.
- B. Handle wiring devices carefully to avoid damage, breaking and scoring.
- C. Store in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.
- B. Device color:
 - 1. Switches, receptacles, and dimmers on normal power shall be white.
 - 2. Switches, receptacles, and dimmers on emergency power shall be red.

3. Mock emergency receptacles shall be red.
4. Isolated ground receptacles shall be orange.
5. Key operated switches shall be gray.
6. Provide receptacles in surface mounted raceways in colors as shown on drawings. Coordinate color of devices and device plates in other areas with the architectural finish. Refer to architectural drawings and specifications.
7. For renovation or expansion of existing facilities, provide devices and plates to match existing.

2.2 WALL SWITCHES

- A. Acceptable manufacturers
 1. Arrow-Hart
 2. Hubbell
 3. General Electric
 4. Leviton
 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00.UT and Division 01 for substitution requirement.
- B. Material
 1. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, 20 amperes and 120/277 volt AC with number of poles as required.
 2. Pilot light type shall be equipped with red toggle handle (glow when on), 20 amperes and 120/277 volt AC with number of poles as required.
 3. Key operated switches shall be Gray, 20 amperes and 120/277 volt AC with number of poles as required key all locks alike. Furnish keys compatible with key switch, quantity as directed by Owner, minimum of ten copies.
 4. Illuminated Emergency-Power-Off switch shall be provided with button guard equal to Allen-Bradley #800T-QA10R or approved substitutions.
 5. A listed manual switch having a horsepower rating not less than the rating of the motor and marked "Suitable as Motor Disconnect" shall be permitted to serve as disconnect means for stationary motor of 2 horsepower or less.
 6. Switch terminal screws or connectors shall be designed to accommodate No. 10 solid conductor.

2.3 RECEPTACLES

- A. Acceptable manufacturers
 1. Arrow-Hart
 2. Hubbell
 3. General Electric
 4. Leviton
 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00.UT and Division 01 for substitution requirement.
- B. Material
 1. Hospital grade receptacles shall be installed in clinic, patient care and other areas required by NFPA. Tamper proof in areas serving children.
 2. Dedicated circuit and convenience duplex receptacles shall be rated 20 amperes, 125 volt AC.
 3. GFCI receptacles shall be rated 20 amperes, 125 volt with integral ground fault current interrupter
 4. Isolated ground duplex receptacles shall be Orange, rated 20 amperes, 125 volt.
 5. Heat trace receptacles shall be Arrow-Hart #5262CRGRY with Crouse Hinds #WLRD-1 cover. Install round plug on cord supplied with heat trace to match weatherproof bushing on receptacle cover for watertight installation.
 6. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.
 7. Heavy-duty lock-blade receptacles shall be NEMA WD5 heavy-duty specification grade.

8. Emergency receptacles shall be red plastic face or with pre-wired neon glow lamp behind each pair of slots as per drawings.
9. Weatherproof receptacles as specified shall be mounted in a cast steel box with gasketed, weatherproof device plate as specified.

2.4 WALL PLATES

- A. Acceptable manufacturers
 1. Arrow-Hart
 2. Hubbell
 3. General Electric
 4. Leviton
 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00.UT and Division 01 for substitution requirement.
- B. Material
 1. Wall plates shall be 316 or 302 stainless steel with cutouts as required for devices indicated on drawings, unless otherwise noted. Where switches or outlets are shown adjacent to each other, they shall be ganged with partitions between different type services and covered by a single custom wall plate.
 2. Exposed boxes:
 - a. Dry interior spaces: Use cast metal plates with cast metal box. Use heavy cadmium-plated sheet steel plates with steel boxes and copper-free aluminum with aluminum boxes. All screws shall be stainless steel. Edges of plates must be flush with edges of boxes.
 - b. Other locations: Use weatherproof devices plates. Provide cast metal plates with gasketed spring door
 3. Jumbo plates are not permitted.
 4. Weatherproof cover plate shall be gasketed cast aluminum or feraloy (by Crouse-Hinds) with hinged gasketed device covers.
 5. Wall plate for isolated ground receptacles shall be silk-screened "ISOLATED GROUND".

2.5 WALL DIMMERS

- A. Acceptable manufacturers
 1. Lutron
 2. Leviton
 3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00.UT and Division 01 for substitution requirement.
- B. Material
 1. Provide NEMA WD 2 solid-state wall-box dimmers, where indicated on drawings. Dimmers shall be complete, with linear slide-type solid-state dimming controls, and LED light level ON/OFF indicators. Dimmer shall produce IES square-law response from blackout to full brightness. Dimmer rise time shall be restricted to prevent interference with professional quality audio or video equipment. Dimmer shall be compatible with ballast per manufacturer's specification.
 2. Device: White finish plastic with linear slide.
 3. Voltage: As noted on drawings.
 4. Power rating: Match load shown; 1000 watts minimum, larger size is required to accommodate connected loads greater than 1000watts. Load to 80% of the dimmer capacity, maximum.

2.6 FLOOR MOUNTED SERVICE FITTINGS AND BOXES

- A. Acceptable manufacturers
 1. Steel City
 2. Walker

3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00.UT and Division 01 for substitution requirement.

B. Material

1. Floor mounted service boxes shall be flush mounted brushed aluminum housing with poke-through assembly. Provide brass cover plate with two hinged lift lids where carpeting is installed.
2. Quantity of outlets for A/V and power per drawings.

2.7 OCCUPANT SENSORS

A. Acceptable manufacturers

1. Pass & Seymour
2. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 26 00 00.UT and Division 01 for substitution requirement.

B. Material

1. Self-mounting, ceiling bracket.
2. Quad element, infrared detector behind a fresnel lens.
3. Detection range
 - a. 8 to 14 micrometer frequency spectrum of bodily emitted infrared radiation.
 - b. 110 degree sensing field over 400 gross square feet.
 - c. Adjustable time-out delay: 5 second – 15 minutes.
 - d. Supplied with plenum rated low voltage wire leads for termination.
 - e. Manual shutoff per sensor is required.
4. Control unit
 - a. Enclosure: Galvanized, heavy duty for mounting to a 4 inch or 4-11/16 inch square box.
 - b. Control up to (7) sensors.
 - c. Power rating
 - 1) 600 watts for incandescent at 120 volts.
 - 2) 2500 watts for fluorescent at 277 volts.
 - d. Supplied with plenum rated low voltage wire leads for termination.

2.8 TAPE LABELS

- A. Provide tape labels in accordance with Section 26 05 53.UT, Electrical Identification, on all receptacles and switches indicating panelboard and circuit number. White tape with 3/16 inch black letters/numbers.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine the areas and conditions under which wiring devices and floor boxes are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect devices for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 DEVICE COORDINATION

- A. Where items of equipment are provided under other sections of this specification or by the Owner, provide a compatible receptacle and/or device plate for the cap or plug, and cord of the equipment.

3.3 INSTALLATION

A. General:

1. Install wiring devices and floor boxes as indicated, in accordance with the applicable requirements of the latest release of NEC, NEMA, and ANSI.

2. The approximate location of switches, power outlets, floor boxes, etc., is indicated on the drawings. These drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the general building drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Constructor Inspector.
 3. Where more than one device occurs in one outlet box, causing 300 volts or more voltage difference between them, a barrier must be provided for isolation to meet NEC Article 380.
- B. Wall Switches and Dimmers:
1. Location:
 - a. Install wall switches and dimmers in suitable outlet box centered at the height of 48 inches above finished floor, OFF position down.
 - b. Where wainscot occurs at the 48" level, install device in the wall below the wainscot and as near the 48" level as possible to provide the most pleasing appearance, but in no case partially in the wainscot and partially in the wall.
 - c. Where shown near doors, install switches and dimmers not less than 2" and not more than 12" from door trim.
 - d. Verify all door swings before rough-in and locate switches and dimmers on strike side of door as finally installed.
 2. Position:
 - a. Wall switches: Install wall switches in a uniform position so the same direction of operation will open and close the circuits throughout the project, generally up or to the left for the ON position.
 - b. Wall dimmers: Install dimmers in a uniform position so the same direction of operation will brighten and dim the lights throughout the project, generally up for brightest position.
 3. Wall Box Dimmers:
 - a. De-rate ganged dimmers as instructed by manufacturer. Do not use common neutral.
 - b. Compatibility: Where dimmers are connected to fluorescent lights, verify with ballast manufacturer and dimmer manufacturer the suitability of the ballast for dimming applications.
 - c. Test: Test dimmers per manufacturer's instructions. Demonstrate that unit's function as specified. Where remote dimmers are provided, demonstrate that unit's function properly as master and remote.
 - d. Burn-in: Where dimmers are connected to fluorescent fixtures, operate at full brightness for the full burn-in duration as specified or recommended by the lamp manufacturer.
- C. Receptacles:
1. Location:
 - a. Install convenience outlets, telephone, data and TV outlets in suitable steel outlet boxes centered at the height of 18 inches above the finished floor, 6 inches above countertop or at the backsplash level, or as indicated on the drawings. Coordinate with equipment and architectural drawings.
 - b. Install receptacles generally where indicated on drawings. The Owner's representative reserves the right to make any reasonable changes in receptacle locations without change in the contract sum.
 - c. Install specific-use receptacles at heights shown on Drawings.
 2. Position:
 - a. Install receptacles vertically with ground pole on bottom. Install receptacles horizontally, where field condition does not allow vertical installation, with ground pole on left.
 3. All receptacles with 6 feet of a water source such as sinks shall be GFCI type. Arrange circuit wiring for last receptacle on circuit to be GFCI. Feed through to non-GFCI receptacles is not permitted.
- D. Plates:
1. Where cover plates do not completely conceal the rough openings for the devices, it shall be the responsibility of the General Contractor to patch, paint, etc. around the opening to the satisfaction of the Owner's representative.

2. All devices and cover plates shall be plumb and parallel to adjacent surfaces or trim. Devices must be flush with the finished trim cover plates and plates must be tight to surfaces over which they are installed.
 3. Where switches controlling devices that are out of sight, or where three or more switches are gang mounted, plates shall be labeled to identify items being controlled, or areas being lighted. Labeling shall be 3/16-inch Condensed Gothic and shall be filled with black enamel.
- E. Floor Boxes:
1. Verify locations of all floor boxes with the Owner's representative before installation. Increase slab thickness at boxes if required to obtain a minimum of 1 inch of concrete below bottom of box.
 2. Install floor boxes level and flush with finish flooring material. Completely envelope floor boxes in concrete except at the top.
 3. Adjust covers flush with finished floor.
- F. Occupant Sensors:
1. Flush mount occupant sensors through round hole cut in ceiling tile, positioning and placement per sensor manufacturer's recommendation.
 2. It is the installer's responsibility to replace damaged ceiling tiles during his installation of sensor.
 3. The low voltage control wiring installed above ceiling tiles shall be plenum rated or general building wiring installed in raceway system.

END OF SECTION 26 27 26

SECTION 26 28 13.UT - FUSES, 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.
- B. Time delay, current limiting Class L fuses for loads up to 600 volts, 601-6000 Amps.

1.2 REFERENCES

- A. UL 248-12 - Standard For Safety For Low-Voltage Fuses-Part 12: Class R Fuses
- B. UL 248-10 - Standard For Safety For Low-Voltage Fuses-Part 10: Class L Fuses
- C. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store fuses in a clean and dry space and protected from weather. When necessary to store outdoors, elevate materials well above grade and enclose with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
 - 1. Motors and Transformers, 0 to 600 Amp:
 - a. 250 volt - Buss LPN-RK, UL Class RK1.
 - b. 600 volt - Buss LPS-RK, UL Class RK1.
 - 2. Lighting Loads, 0 to 600 Amp:
 - a. 250 volt - Buss KTN-R, UL Class RK1.
 - b. 600 volt - Buss KTS-R, UL Class RK1.
 - 3. All Applications, 601 to 6000 Amp:
 - a. 600 volt - Buss KRP-C, UL Class L.
- B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150% to 175% of motor nameplate rating per NEC in accordance to the type of motor.
- C. Interrupting Rating: 300,000 RMS Amps.
- D. Maintenance Stock, Fuses:
 - 1. Furnish the following:
 - a. Three spare fuses of each size and type for a spare set.
 - b. Furnish spare fuse cabinet sized to contain required spare fuse stock.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, national and local codes, regulations, and requirements.

- B. Provide quantity of spare fuses and fuse cabinet per the requirement of this Section at the location per drawing or the direction of Owner's Representative, in addition to replace blown or defective fuses during installation, startup, system commissioning and acceptance.

END OF SECTION 26 28 13

SECTION 26 28 16.UT (PREVIOUSLY SECTION 16170) - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Disconnect switches, fusible and non-fusible.
- B. Enclosures.

1.2 REFERENCES

- A. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface-Mounted.
- B. NEMA KS 1 - Enclosed Switches.
- C. NFPA 70 - National Electrical Code
- D. NFPA 70E - Electrical Safety Requirement for Employee Workplaces
- E. UL 98 - Enclosed Switches1.

1.3 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 01for submittal requirement.
- B. Submit manufacturer's product data. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.
- B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.
- C. Store switches in a clean and dry space and protected from weather.

PART 2 - PRODUCTS

2.1 FABRICATED SWITCHES

- A. NEMA KS 1; Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Handle lockable in ON position for service entrance disconnect. Provide defeater so that qualified personnel can open door while switch is in the closed position.
- B. Use switches that have number of poles required as per drawings.
- C. Switches shall be Underwriters' approved for duty shown and enclosure type per drawings. NEMA 3R switches shall be provided where exposed to weather. NEMA 3R switches shall have weatherproof threaded hubs for all conduit entries into switch.
- D. Use fuse clips that are rejecting type to accept Class RK or L fuses only.
- E. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to 26 05 53 Electrical Identification Section of this specification.
- F. Voltage rating: 240VAC or 600VAC as per drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES

- A. Install safety or disconnect switches, where required by NEC, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on switch and adjacent equipment.
- B. For equipment with motors larger than 1/8 hp, install disconnect switches within sight of the motor.
- C. Provide fused disconnect switches, whether or not indicated on drawings, when required to maintain equipment manufacturer's warranty. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.
- D. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.
- E. Wall mount switches, where possible, or mount on unistrut supports.

END OF SECTION 26 28 16

SECTION 26 51 00.UT (PREVIOUSLY SECTION 16501) - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Interior lighting fixtures and accessories
- B. Emergency exit signs
- C. Emergency LED power supplies
- D. Lighting controls

1.2 REFERENCES

- A. NEPA 101 - Code for Safety to Life from Fire in Buildings and Structures
- B. NEMA WD1 - General-Purpose Wiring Devices
- C. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts
- D. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type)
- E. NEMA LE - H-I-D Lighting System Noise Criterion (LS-NC) Ratings
- F. UL 844 - Electric Lighting Fixtures for Use in hazardous (classified) Locations
- G. UL 924 - Emergency Lighting and Power Equipment
- H. UL 1574 – Track Lighting Systems
- I. IESNA – Lighting Handbook
- J. NEMA WD 1 - General Color Requirements for Wiring devices
- K. NEMA LE 5B – Procedure for Determine Luminaire Efficacy Ratings for High-Intensity Discharge Industrial Luminaires
- L. NFPA 70 – National Electrical Code
- M. ASHRAE/IES 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- N. Standards For State-Funded Outdoor Lighting Fixture – Texas House Bill 916 (1999)
- O. UT System OFPC – Security Planning and Design Guidelines (2002 release)

1.3 DESIGN CRITERIA

- A. Lighting level design shall be per IESNA (Illuminating Engineering Society of North America) recommendation.
- B. The power consumption for interior and exterior lighting shall not exceed power allowance as per ASHRAE 90.1 latest revision.

1.4 SUBMITTALS

- A. Provide submittals in accordance with and in additional to Section 26 00 00.UT, Basic Electrical Requirements, and Division 1 for submittal requirement.
- B. Submit manufacturer's data on interior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled.

- C. Submit dimensioned drawings and performance data including complete photometric test data for each luminaire, candlepower distribution curves in two or more planes, candlepower chart zero to 90 degrees, lumen output zonal summary chart, average and maximum brightness data, and coefficients of utilization for zonal cavity calculations, spacing to mounting height ration, efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaries type.
- D. Lamps: Catalog cuts showing voltages, colors, approximate hours life, approximate initial lumens, and lumen maintenance curve.
- E. LED Drivers: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.
- F. Controls: Catalog cuts and/or shop drawings showing dimensions, voltage capacity, contact ratings, wiring diagrams, operating levels, and temperature ratings.
- G. Lighting design shall be in compliance with power allowance for lighting, which is stipulated by ASHRAE 90.1. Compliance forms along with engineering data associated with it shall be submitted for Owner's review during design phase.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper.
- B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
- C. Store lighting fixtures in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.
- B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, poles and wiring.

2.2 INTERIOR LIGHTING FIXTURES

- A. Fluorescent Fixtures
 1. Lenses shall be UV stabilized, injection-molded, clear, 0.150- inch minimum thickness virgin acrylic. Provide a minimum of 8 hold-down lens retaining clips for troffers utilizing framed diffuser lenses.
 2. Parabolic aluminum louvers shall be semi-specular, low-iridescence finish silver anodized aluminum, 2 or 3 inches deep as per drawings. Louvers shall be roll formed with roll grain horizontal to view plane. Louver intersections shall be of a close-fitting, tab-and-slot construction permitting no light leaks.
 3. Parabolic plastic louvers shall be vacuum-metalized polystyrene with specular finish and antistatic properties.
 4. Lighting fixture door frames shall be flush steel hinged and equipped with rotary-action cam latches.
 5. Lighting fixture housing shall be minimum 22-gauge, cold-rolled steel with pre-punched knockouts and access plate for electrical connections. End plates shall be minimum 20-gauge with pre-punched hanger holes. Ballast mounts shall be separated for heat dissipation.
 6. Three lamp luminaries for dual level switching shall have outer two lamps on one ballast, inner lamp on second ballast, shared with adjacent luminaire's inner lamp if practical.
- B. Incandescent fixtures shall be pre-wired equipped with integral thermal protection. Use incandescent only where aesthetics outweighs economic considerations.

- C. Reflector Finishes
 - 1. Painted Finishes: Provide electro-statically applied dry polyester white powder coat finish with minimum reflectance of 88 percent on all light reflecting surfaces.
 - 2. Specular/Semispecular Finishes: Provide Alzak-type anodized finish on aluminum louvers and reflectors as specified in Luminaire Schedule as shown on the drawings. Minimum reflectivity shall be:
 - a. Specular: 80 percent
 - b. Semi-specular: 75 percent
- D. UL Listing
 - 1. All Luminaries and components shall be UL tested, listed, and labeled.
 - 2. Luminaries installed under canopies, roofs, or similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
 - 3. Recessed luminaries installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall be approved for the installation in a fire-rated ceiling.

2.3 EXIT SIGNS

- A. Acceptable Manufacturers
 - 1. Dual Lite
 - 2. Lithonia
 - 3. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 16010, and Division 1 for substitution requirement.
- B. General Requirements
 - 1. Provide red LED with red diffuser exit signs at the locations per drawings. Exit signs shall have stencil face, 6-inch high red letters on white background, or as specified otherwise, with red Chevron type directional arrows as indicated on drawings.
 - 2. Battery backed exit signs shall be provided with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully-automatic charger. Provide test switch to manually transfer unit from normal supply to battery supply.
 - 3. Battery shall be sealed maintenance free, nickel cadmium type, 6 or 12 volts, 24-watt rated capacity, with 1.5 hour minimum capacity to supply connected lamp load.
 - 4. Unit shall be 120 or 277 volt.

2.4 LIGHTING CONTROL

- A. Refer to Section 26 27 26.UT Wiring Devices and Floor Boxes for lighting switch, dimming control, and occupancy sensor.
- B. Photocell shall be automatic dawn on, dusk off switching; moisture, temperature, and vibration-resistant die-cast aluminum housing; time delay feature to prevent false switching; field adjustable to control operating levels.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to order lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings that lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, ballast, voltage and etc. shall be brought to the attention of A/E by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.
- B. Installer shall examine the areas and conditions that light fixtures are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LIGHTING FIXTURES

- A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC and national and local code, standard, and regulations. Install lamps in accordance with manufacturer's instructions.
- B. Install luminaries at locations as shown on the Drawings; install aligned, aimed, and leveled. Install fixtures in accordance with manufacturer's installation instructions complete with mounting accessories, trim and support materials. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.
- C. Coordinate with other crafts to avoid conflicts between luminaires, supports, fittings and mechanical equipment.
- D. Surface Mounted Fixture:
 - 1. Mount with support rails attached to ceiling suspension support system, provided ceiling system has been certified to be suitable to support weight of fixtures.
 - 2. Where ceiling system has not been certified to support weight of fixtures, fixtures shall be supported at four points near each corner of fixtures.
 - 3. Provide a minimum 5/8" air space between the fixture and the ceiling.
- E. Recessed Fixtures:
 - 1. Handle specular/semi-specular louvers and down light cones using only new clean white cotton or silk gloves. Do not touch louvers or cones with bare hands. Leave luminaries clean and free of any visible dust, debris, or fingerprints with all lamps operational at time of acceptance of work.
 - 2. All recessed fluorescent fixtures shall be supported from building structure above ceiling with galvanized steel wire at not less than 4 points near corners of fixture. Size of wire shall be capable of supporting weight of fixtures.
 - 3. Recessed luminaries trims shall fit snugly to the mounting surface and shall not exhibit light leaks or gaps. Provide feed-through junction boxes or provide separate junction boxes. All components shall be accessible through the ceiling opening.
 - 4. Connect recessed luminaries to junction box with flexible steel conduit and fixture wire.
- F. Lighting Fixtures Adjustment
 - 1. Adjust to illuminate intended areas as directed.
 - 2. Adjust fixtures during hours of darkness.
- G. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and lamp and test all fixtures for electrical as well as mechanical operation.
- H. Protect installed fixtures from damage during the remainder of the construction period.
- I. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- J. Lamp Disposal
 - 1. The procedure of disposal of lamps that are mercury containing shall follow the guideline set by EPA (definitions in Title 40 Code of Federal Regulations 261 Subpart C, January 2000).

END OF SECTION 26 51 00

SECTION 27 00 00 - COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general design requirements, administration topics, and installation for communications systems.

1.2 SYSTEM DESCRIPTION

- A. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.
- B. Related Sections
 1. Section 260000 Electrical (including related sub-sections)
 2. Section 270526 Grounding and Bonding for Communications Systems
 3. Section 270528 Pathways for Communications
 4. Section 271100 Communications Equipment Room Fittings
 5. Section 271300 Communications Backbone Cabling
 6. Section 271500 Communications Horizontal Cabling
 7. Section 274100 Audio-Visual Systems (including related sub-sections)

1.3 SCOPE OF WORK

- A. This section establishes an infrastructure to be used as signal pathways for communications systems, but is not limited to the following:
 1. Comply with all UTHSC Cabling Standards and all Project Contract documents and the following requirements for a complete project installation.
 2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing and testing of: backbone cabling, riser cabling; data and voice horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware and patch panels.
 3. Furnish all labor, materials, tools, equipment and services for the installation described herein.
 4. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.
- B. Work of this section covers complete installation of permanent and channel links for a data and voice communications networks utilizing copper and fiber transmission media that includes, but is not limited to the following:
 1. Provide, install, terminate, test, and document all fiber and copper backbone cables, riser cables, and horizontal cables.
 2. Provide and install all termination devices such as, but not limited to, modular patch panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits. Document all termination devices with proper labeling.
 3. Provide in quantities specified, interconnect components such as, but not limited to, fiber patch cables, copper patch cords, and station cables.
 4. Provide and install specified Telecommunication Room equipment such as, but not limited to, racks, cabinets, horizontal and vertical cable support devices, cable trays and cable runway, and required mounting brackets/hardware.

5. Provide and install UL-approved firestopping systems in all communication pass-through locations of rated ceiling, wall or floor penetrations involving, conduits, cable, and cable trays in coordination with General Contractor.
6. Provide and install grounding and bonding connection to the bus (TGMB/TGB) provided by Division 26.
7. Provide and install all appropriate consumable items required to complete the installation.
8. Coordination with other trades.
9. Provide complete documentation and demonstration of work.
10. Provide indexed and organized complete Test Results of all copper and fiber cable and their components in native format.
11. Provide Submittals as outlined below.
12. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this wiring system.
13. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the final product, test results, and As-Built Drawings.

C. Changes to the Scope of Work

1. Owner changes to the scope of work shall be in writing.
2. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.
3. The Contractor shall respond to these changes with a complete material list, including pricing, labor, and taxes in writing to be presented to the Owner for approval.
4. The Contractor shall not proceed with additional scope of work without signed approval by the Owner. Owner will not pay for additional work performed by the Contractor without written/signed approval of these changes.
5. Contractor will attach a copy of the signed change order with billing information.

1.4 PRODUCTS AND WORK BY OTHERS (NIC)

- A. The Owner may separately procure and/or provide certain equipment and component that will be installed during the course of project. Such items may not be indicated in the documents.
- B. Contractor shall cooperate with the Owner and Owner's suppliers when considering:
 1. The provision and installation of phone systems, related system equipment/software, and employee station equipment/software.
 2. The provision and installation of multi-port routers, switches, and other Layer 2 / Layer 3 networking components in communications rooms.
 3. The provision and installation of Uninterruptable Power Source (UPS) devices in communications rooms.
 4. Communications grounding busbars and grounding wires connecting to the main building electrode system.
 5. Dedicated power panels, ground busbars, circuits, and utility outlets.
 6. The installation and finishing of plywood backboards.
 7. Building mechanical ductwork, cooling/heating system (HVAC), and environmental control sensors.
 8. Communication pathway devices such as, but not limited to, cable tray and flex-tray in corridors, office spaces and open areas, outlet boxes and stub-ups, conduits, conduit sleeves, and penetrations in walls and floors.

1.5 SUBSTITUTION PROCEDURES

- A. Substitution may be considered when a product becomes unavailable through no fault of the Contractor. An alternate product must be equal to or exceed specified requirements. The material substituted shall not void, alter or change manufacturers' structured cabling system warranty.

- B. Document substitution requests with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:
 - 1. Product identification, manufacturer's name and address.
 - 2. Product Data:
 - a) Description, performance and test data, reference standards, finishes and colors.
 - b) Samples: Finishes.
 - c) Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
 - d) Data relating to changes required in construction schedule.
 - e) Cost comparison between specified and proposed substitution.
- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- D. The Owner will be the final judge of acceptability, with review by DataCom Design Group and the distribution of the acceptance by the Architect.
- E. No substitute shall be ordered, installed or utilized without the Architect's prior written verification of acceptance from the Owner.

1.6 REFERENCES AND RELATED DOCUMENTS

- A. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, Architectural plans and specifications, requirements of Division 1, Electrical, Mechanical, Plumbing, Audio-Visual, Security and Communications specifications and plans, and the publications listed below apply to the Communications section, are incorporated into this specification by reference, and shall be considered a part of this section.
- B. Reference to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.
- C. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.
- D. Conflicts
 - 1. Drawings and specifications are to be used in conjunction with one another and to supplement one another.
 - 2. In general, the specifications determine the nature and quality of the materials and tests, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to during the installation of the communications system components.
 - 3. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity and/or quality shall be estimated and installed.
 - 4. Clarification with the Owner and/or DataCom Design Group about these items shall be made in writing prior to procurement and installation.
- E. Codes and Standards
 - 1. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)
 - a) ANSI/TIA-568.0-D "Generic Telecommunications Cabling for Customer Premises"
 - b) ANSI/TIA-568.1-D "Commercial Building Telecommunications Infrastructure Standard"
 - c) ANSI/TIA-568-C.2 "Balanced Twisted-Pair Telecommunication Cabling and Components Standard"
 - d) ANSI/TIA-568-D.3 "Optical Fiber Cabling Components Standard"
 - e) ANSI/TIA-568-D.4 "Broadband Coaxial Cabling and Components Standard"

- f) ANSI/TIA-569-D "Telecommunications Pathways and Spaces"
 - g) ANSI/TIA-606-C "Administration Standard for Commercial Telecommunications Infrastructure"
 - h) ANSI/TIA-607-C "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications"
 - i) ANSI/TIA-758-C "Customer-Owned Outside Plant Telecommunications Infrastructure Standard"
 - j) ANSI/TIA-862-B "Building Automation Systems Cabling Standard"
 - k) ANSI/TIA-942-A: "Telecommunications Infrastructure Standard for Data Centers"
 - l) ANSI/TIA-1152-A: "Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling"
- 2. American National Standards Institute (ANSI)
 - a) ANSI C80.1 Electrical rigid steel conduit (ersc)
 - 3. BICSI
 - a) BICSI Outside Plant Design Reference Manual
 - b) BICSI Telecommunications Distribution Methods Manual (TDMM)
 - 4. Local, county, state and federal regulations and codes in effect as of date of installation.
 - 5. Equipment of foreign manufacture must meet U.S. codes and standards.
 - a) It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.7 QUALITY ASSURANCE

- A. Communications Contractor shall have a complete working knowledge of low voltage communications cabling applications such as, but not limited to data, voice and video network systems.
- B. Communications Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document.
- C. Communications Contractor and individual installation crew members shall be experienced and qualified to perform the work specified herein at time of bid submission. All onsite supervision personnel that will be assigned to this project shall be listed in the Pre-Installation Submittal.
 - 1. 80% shall have a minimum of three (3) years of experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid.
 - 2. All installation team members must demonstrate knowledge and compliance with all applicable methods, standards, and codes.
 - 3. All members of the installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls under manufacturer's guidelines necessary to obtain the Manufacturer's System Assurance Warranty.
 - 4. Any personnel substitutions shall be noted in writing to the Owner.
- D. A BICSI RCDD shall supervise and approve all on-site work as a recognized member of the Contractor's installation team.
- E. Refer also to General Conditions.

1.8 CONTRACTOR REQUIREMENTS

- A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.
- B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete communications cabling infrastructure system. Pay all required sales, gross receipts, and other taxes.
- C. Regulatory Requirements

1. Communications Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).
 2. Communications Contractor shall be licensed and/or bonded as required for telecommunications/low voltage cabling systems.
- D. Use of Subcontractors
1. Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.
 2. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.
- E. The Contractor's designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.
- F. Coordination
1. Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.
 2. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components.
 3. Exchange information and agree on details of equipment arrangements and installation interfaces.
 4. Coordinate with electrical contractors and plan for the pathway routes used communications cabling to minimize cable lengths. Report any potential over distance cable runs for approval before pulling the cables.
 5. Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.
- 1.9 PRE-INSTALLATION MEETINGS
- A. Communications Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and clarify questions in writing with consultant and/or project manager/Owner representative.
- B. Agenda
1. Safety
 2. Work to be performed
 3. Scheduling
 4. Coordination
 5. Other topics as necessary
- C. Attendance
1. Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
 2. All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of communications cables on the project.
- 1.10 CONTRACT ADMINISTRATION
- A. DataCom Design Group may perform site visits and provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.

- B. Job Field Report outline:
 - 1. General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
 - 2. Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.11 POST INSTALLATION MEETINGS

- A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.
- B. Attendees shall include
 - 1. Communications Contractor
 - 2. Project Manager/Owner Representative
 - 3. DataCom Design Group
 - 4. General Contractor
 - 5. Other trades that the GC deems appropriate.
- C. At this meeting the Communications Contractor shall present and explain all documentation.
- D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Communications Contractor and resubmitted within one (1) week of the meeting.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.
- B. Communications Contractor requirements:
 - 1. Be responsible for prompt material deliveries to meet contracted completion date.
 - 2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
 - 3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
 - 4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
 - 5. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.
 - 6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
 - 7. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.
 - 8. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.

1.13 WARRANTY

- A. The Contractor shall be a certified Manufacturer's Value Added Reseller (VAR) and/or Authorized Installer and provide an end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.
- B. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.
- C. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.

1. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.
 2. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the contract documents, and support all current and future network applications for a minimum of twenty (20) years.
- D. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.14 PAYMENT

- A. Refer to the General Contractor contract documents and/or master specifications issued by Architect for project and cost payment details.

1.15 SUBMITTALS

- A. Refer to Requirements of Division 1.
- B. Refer to Sections 271300 and 271500.
- C. The Communications Contractor shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal in writing. Such work shall be in accordance with approved submittals.
- D. Pre-Installation Submittal Requirements
1. Communications Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.
 2. City, county, and/or state telecommunication cabling permits as required by Authority Having Jurisdiction (AHJ).
 3. Executed non-disclosure agreement.
 4. Appoint a Project Manager and provide the name and contact information.
 5. Shop Drawings
 - a) Communications Contractor shall submit, for approval, floor plans that identify all device locations, cable routes, cable lengths, cable quantities and cable types, riser locations, and references to installation details and diagrams.
 - i) Communication Contractor shall notify Owner of cable routes exceeding standardized lengths.
 - b) Communications Contractor shall submit, for approval, diagrams that show room layouts, rack layouts (including elevations), riser layouts, etc.
 - c) The Contractor shall make any corrections as required by the consultant team and submit revised shop drawings to the team for approval.
 - d) Approval by the Consultant of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.
 - e) Release of CAD Files
 - i) Contractor may request to utilize the DataCom Design Group AutoCAD floor plan files for assistance in producing shop drawings.
 - ii) Request shall be made by signing the DataCom Design Group "Agreement for Release of CAD Files" letter.

6. Product Data Cut-sheets
 - a) Communications Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.
 - b) Communications Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
7. Warranty
 - a) The Communications Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.
 - b) All subsequent work shall be in accordance with approved submittals. The Communications Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.
8. Qualifications
 - a) Communications Contractor shall submit a list of the Contractor's previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:
 - i) At least ten (10) other projects in the last five (5) years
 - ii) Name and location of project
 - iii) Project contacts, email addresses, and phone numbers
 - iv) Total square footage
 - v) Total number of cables/drops
 - vi) Types of media
 - b) Communications Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.
 - i) Communications Contractor Employees
 - ii) Subcontractors
 - c) Manufacturer certifications for Contractor and installers.
9. Cable Testing Plan
 - a) The Contractor shall provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber components and accessories prior to beginning cable testing.
 - b) The following minimal items shall be submitted for review:
 - i) A testing plan that clearly describes procedures and methods.
 - ii) Product data for test equipment.
 - iii) Certifications and qualifications of all persons conducting the testing.
 - iv) Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
 - v) Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.
10. Samples
 - a) For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

E. Closeout Submittal Requirements

1. As-Built Drawings
 - a) Communications Design drawings are to be supplied to the Architect to prepare the master "As-Built" drawings.
 - b) Submit one electronic copy and one hard copy with project deliverables within three (3) weeks subsequent to substantial completion. Provide a laminated floorplan with drop designations in the respective serving Telecom Room.
 - c) As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing sheets used for the contract documents.
 - d) Utilize normal recognized drafting procedures that match AutoCAD standards, Architect and Consultant guidelines, and methodology.
 - e) The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
 - 1) Contractor shall clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
 - 2) Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.
 - f) Provide dimensioned plan and elevation views of networking components, showing:
 - i) All work area outlet locations complete with outlet/cable labeling.
 - ii) Rack and/or cabinet locations complete with labeling.
 - iii) One-line diagram of equipment/device interconnections with the cable plant.
 - iv) Standard or typical details of installations unique to Owner's requirements.
 - v) Graphic symbols and component identification on detail drawing shall conform to the latest conventions.
 - vi) ANSI/TIA-568-C.0 "Generic Telecommunications Cabling for Customer Premises"
 - vii) ANSI/TIA-569-C "Telecommunications Pathways and Spaces"
 - viii) ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure"
 - ix) ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications"
2. The Communications Contractor shall deliver the Installer's Extended Product Warranty and Manufacturer's signed System Assurance Warranty of installed cabling system to include all components that comprise the complete cabling system.
 - a) Delivery shall be completed within two (2) weeks of the time of final punch list review.
 - b) Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
3. Cable Testing Report Requirements
 - a) Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.
 - b) The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
 - c) Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.
 - d) Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination components. Include products furnished:

- i) Manufacturer's name
 - ii) Manufacturer's part numbers
 - iii) Cable designations
 - iv) Location and riser assignments
 - v) Product Data
4. Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
- F. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
- B. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
 - 1. All shall be typical commercial designs that comply with the requirements specified.
 - 2. All material and equipment shall be readily available through manufacturers and/or distributors.
- C. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.
- D. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.
- E. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.
- F. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.
- G. Backward Compatibility: The provided products shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower category's specified parameters.
- H. Component Compliance: The provided products shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

2.2 ACCEPTABLE MANUFACTURERS

- A. Identification (Labeling) System
 - 1. Brady
 - 2. Dymo
 - 3. Hellerman-Tyton
 - 4. Acceptable alternate
- B. Fire-Stop Systems
 - 1. Hilti
 - 2. SpecSeal

3. 3M
 4. Acceptable alternate
- C. Horizontal Copper Cabling Solution:
1. Panduit
 2. CommScope
 3. No Substitutes
- D. Other Products as Referenced in other Division 27 Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field Measurements
1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
- B. Established Dimensions
1. Where field measurements cannot be made without delaying the work, coordinate with the General Contractor to establish dimensions.
 2. When approved in writing, proceed with fabricating units without field measurements.
 3. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.
- C. Pre-installation inspection
1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.
 2. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.2 INSTALLATION

- A. General
1. Contractor shall install work in accordance with specifications, drawings, manufacturer's instructions and approved submittal data.
- B. Allowable cable bend radius and pull tension:
- a) In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation.
 - b) Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
 - c) After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.
- C. Pull Strings
1. Provide pull strings in all new conduits, including all conduits with cable installed (trailer strings) as part of this contract.
 2. Data and video cables can be pulled in tandem with pull strings.
 3. The pull strings must move freely to prevent cable jacket/cable damage during pulls.
- D. Labeling
1. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
 2. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.
 3. Provide transparent plastic label holders, and 4-pair marked colored labels.

4. In accordance with ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure":
 - a) Install colored labels according to the type of field as per color code designations.
 - b) Use "designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields".
 5. Pathway Labels and Labeling System
 - a) Labeling system shall consist of a hand-held portable printer
 - b) Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.
 - c) Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.
 - d) Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.
 - e) All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.
 - f) Identification
 - i) All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.
 - ii) Conduits shall be labeled with the word "communications" and the conduit's origination room number and destination room number.
 - iii) The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.
 - iv) Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.
 - v) The Contractor shall label conduit sleeves at each wall and floor penetration.
- E. Firestop
1. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system.
 2. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for communications infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.
 3. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.
 4. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.
 5. Using a "ring and string" method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.
 6. Coordinate firestopping procedures and materials with General Contractor.
 7. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.
 8. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0'-4".
 9. Provide and install removable, intumescent, firestop bricks for all openings greater than 0'-4" where there are penetrations through walls.
 10. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers' specifications.
 11. Provide manufacturer recommended material for rated protection for any given barrier.
 12. Laminate and permanently affix adjacent to chases the following information:
 - a) Manufacturer of firestop system.

- b) Date of installation/repair.
 - c) Part and model numbers of system and all components.
 - d) Name and phone numbers of local distributor and manufacturer's corporate headquarters.
13. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.
14. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.
15. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.
16. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
- F. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.
- G. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.
- H. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.
- I. System Tests
- 1. Upon completion of the installation of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
 - a) Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
 - b) Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.
 - c) Approved instruments, apparatus, services, and qualified personnel shall be utilized.
 - d) The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below.
 - e) This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.
 - 2. Non-Compliant Cabling
 - a) Testing that shows some or all pairs of a cable do not comply with specifications, without written approval by the Owner, shall be replaced at Contractor's expense (including respective connectors).
 - b) With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.
 - 1) Testing is still required for non-compliant cabling.
 - 2) The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground.
 - 3) The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.
 - 3. Failed Tests

- a) If tests fail, Contractor shall correct as required to produce a legitimate passing test.
 - b) Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
 - c) If the Contractor is found to have manipulated or falsified any failing test result to show a "PASS" for any reason (without written notice and prior approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.
4. Owner reserves the right to be present during any or all testing.

3.3 CLEANING

- A. The Contractor will clean all surfaces prior to final acceptance by Owner.

3.4 COMPLETION INSPECTION AND PUNCH LIST

- A. When the Contractor determines that the Scope of Work has been completed in accordance with the plans and specifications, Contractor shall schedule a Completion Inspection with the Owner.
- B. A Punch List will be generated during the Completion Inspection containing deficiencies in need of corrective action.
- C. Complete all punch list deficiencies within 10 working days. The work is not complete until all punch list deficiencies have been addressed.

3.5 ACCEPTANCE

- A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.
- B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
- C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION 27 00 00

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

GENERAL

1.1 SUMMARY

- A. This section includes grounding and bonding products, design requirements and installation for communications systems.
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270528 Pathways for Communications Systems
 - 4. Section 271100 Communications Equipment Room Fittings
 - 5. Section 271300 Communications Backbone Cabling
 - 6. Section 271500 Communications Horizontal Cabling
 - 7. Section 274100 Audio-Visual Systems

1.2 REFERENCES

- A. The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to Section 270000.
- D. Codes and Standards
 - 1. Refer to Section 270000.

1.3 SYSTEM REQUIREMENTS

- A. General
 - 1. All conductor wire, busbars and conduit shall be UL listed.
 - 2. The communications ground system shall be independent from all power grounding except for the connection to the building's electrical service main grounding electrode system.
 - 3. Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.
- B. Telecommunications Main Grounding Busbar (TMGB) and Bonding Conductor for Telecommunications (BCT)
 - 1. The main ground source feed for the Telecommunications Main Grounding Busbar (TMGB) in the MC (MDF) shall be an independent feed from the building's electrical service main grounding electrode system, known as the Bonding Conductor for Telecommunications (BCT).
 - 2. The BCT shall be a stranded copper ground wire from the building ground system to the TMGB in the MC (MDF) sized at a minimum #4/0 unless otherwise sized by the Electrical Engineer of Record.
 - 3. The BCT connections shall be low emission exothermic welds at the connecting ends.
- C. Telecommunication Bonding Backbone (TBB) and Telecommunications Grounding Busbar (TGB)
 - 1. The Telecommunication Bonding Backbone (TBB) originates at the TMGB and shall be extended from the TMGB within the MC (MDF) throughout the building along the same route as the telecommunications backbone pathways, to the Telecommunications Grounding Busbar(s) (TGBs) in each TR (IDF).

2. The minimum TBB conductor size between busbars shall be a stranded copper ground wire one (1) AWG size smaller than the Bonding Conductor for Telecommunications (BCT).

D. TEBC and RBC

1. All cabinets and racks shall be connected by the Telecommunications Equipment Bonding Conductor (TEBC). The TEBC is a stranded copper #4 conductor from the TMGB/TGB extending along each row of racks within the room. Bond each rack with a Rack Bonding Conductor (RBC). The RBC is a stranded copper #6 conductor connected to the vertical rack bonding terminal. All connections shall be irreversible crimp connections. Route conductor so as to minimize the quantity of sweeping bends.

1.4 SUBMITTALS

- A. Refer to Section 270000.

1.5 QUALITY ASSURANCE

- A. Refer to Section 270000.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 270000.
- B. The Contractor shall ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

PRODUCTS

1.7 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:
- B. Cable Manufacturers
 1. Houston Wire and Cable Company
 2. Okonite Company
 3. General Cable
 4. Pirelli Cable Corporation
 5. Triangle Wire and Cable
 6. Owner Approved Alternate
- C. Electrical Service Entrance Bonding Conductor and Connector Manufacturers
 1. Copperweld
 2. Thomas & Betts
 3. Blackburn
 4. Owner Approved Alternate
- D. Exothermic Connector Manufacturers
 1. Erico Products (Cadweld)
 2. Continental Industries (thermOweld)
 3. Harger
 4. Owner Approved Alternate
- E. Crimp Connector Manufacturers
 1. Thomas & Betts
 2. FCI Burndy Electrical
 3. O-Z/Gedney
 4. Owner Approved Alternate

- F. Telecommunication Grounding Busbars
 - 1. Chatsworth
 - 2. Panduit
 - 3. Leviton
 - 4. Owner Approved Alternate
 - G. Bonding Straps
 - 1. Chatsworth
 - 2. Harger
 - 3. Brundy
 - 4. Owner Approved Alternate
 - H. C-Type Compression Taps
 - 1. Brundy
 - 2. Harger
 - 3. Owner Approved Alternate
 - I. Antioxidant Joint Compound
 - 1. Chatsworth
 - 2. Owner Approved Alternate
 - J. Labeling
 - 1. Refer to Section 270000.
 - K. Firestopping
 - 1. Refer to Section 270000.
- 1.8 MATERIALS
- A. Communications Grounding Conductors: Copper American Wire Gauge (AWG) wire of the following sizes:
 - 1. Bonding Conductor for Telecommunications (BCT): #4/0 (unless otherwise sized by the Electrical Engineer of Record)
 - 2. Telecommunication Bonding Backbone (TBB): #3/0 (unless otherwise sized by the Electrical Engineer of Record)
 - 3. Grounding Equalizer (GE): equal AWG as the TBB (unless otherwise sized by the Electrical Engineer of Record)
 - 4. Telecommunications Equipment Bonding Conductor (TEBC): #4
 - 5. Rack Bonding Conductor (RBC): #6
 - B. Grounding Connectors
 - 1. Connectors shall be a copper alloy material and two-hole, double-crimp compression lug type at the connecting ends.
 - C. Telecommunications Main Ground Busbar (TMGB)
 - 1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
 - 2. Sized for the immediate requirements and allow for 25% growth.
 - 3. The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 2'-0" long.
 - 4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
 - 5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.
 - D. Telecommunications Ground Busbar (TGB)
 - 1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
 - 2. Sized for the immediate requirements and allow for 25% growth.
 - 3. The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 3'-0" long.

4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
 5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression type copper lugs.
- E. Equipment Cabinet and Rack Ground Busbar
1. Provide and install a vertical ground busbar in all racks and equipment cabinets to be used as an equipment grounding bus.
 2. The busbar shall be equal-flange (channel) 1'-7" (19) rack width and shall include ground bar, splice plate and #12-24 mounting hardware.
 3. The minimum dimensions shall be 0'- $\frac{3}{4}$ " in width by 0'- $\frac{3}{16}$ " in thickness.
 4. The busbar shall have pre-drilled holes and shall be suitable for use with two-hole compression-type copper lugs.

EXECUTION

1.9 EXAMINATION

- A. Refer to Section 270000.

1.10 PREPARATION

- A. Refer to Section 270000.
- B. Copper and copper alloy connections should be cleaned prior to connection.

1.11 INSTALLATION

- A. Refer to Section 270000.
- B. The Contractor shall install the work in accordance with the specifications, drawings, manufacturer's instructions and approved submittal data.
- C. All work shall be supervised and reviewed by the Contractor's on-site RCDD.
- D. Installation plans and Requests For Information (RFIs) shall be reviewed by the Contractor's RCDD.
- E. General
1. Bonding and grounding procedures and components shall comply with ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications".
 2. Bonding should be accomplished such that the bonding system is integrated and compliant with NEC specifications.
 3. Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded.
 4. Bonding connections should be made by using compression copper lugs. However, for parts of the ground electrode system that are subject to corrosion, must carry high currents reliably, or for locations that require minimum maintenance, connections are made with low emission exothermic welding (see NEC Article 250).
 5. Make connections to dry surfaces only.
 6. Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection.
 7. Burnish clean a 0'-1" X 0'-1" area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt conductor and connector to burnished and compounded area. Ensure proper conductivity.
 8. Route bonding conductor(s) the shortest distance between bonding contact points.
 9. The ground-wire connecting ends shall have a minimum amount of insulation removed at the ground lug.

10. Do not connect ground wire in power cable assemblies to the telecommunications ground system.
 11. All grounding and bonding conductors shall be copper and may be insulated. If bare-bonding conductors are used, isolate bonding conductors and prevent contact.
 12. Antioxidant material shall be installed to separate dissimilar metals and prevent corrosion.
 13. If multiple systems are involved (lightning protection systems, communications, radio and TV, CATV, etc.), those systems shall be bonded together to minimize potential differences between the systems, per NEC 250.94.
- F. Telecommunication Bonding Conductors
1. Each telecommunications grounding and bonding conductor shall be labeled at each end detailing the function and room number of its opposite end. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic and include the following text, "TELECOMMUNICATIONS GROUND - DO NOT REMOVE. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".
 2. Furnish and install all required bonding material, hardware, and utilize tools manufactured for this purpose.
 3. The connections of the BCT, TBB, GE, TEBC, and RBC shall be made using low emission exothermic welding or hydraulically crimped with a double crimp connector. Two-hole grounding lugs are preferred for connection to the grounding bus bars.
 - a) All low emission exothermic welding shall be by Division 26.
 - b) Coordinate with the building services personnel in occupied spaces to prevent the smoke from the exothermic weld process from potentially setting off smoke/fire alarms.
 4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in a ferrous metallic conduit that exceeds 1m (3ft) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6AWG conductor, minimum.
 5. The bonding conductors should be installed without splices.
 - a) Where splices are necessary, the number of splices should be minimized, be accessible, and be located within the telecommunications spaces.
 - b) Joined segments of a bonding conductor shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.
- G. Equipment Cabinets and Racks
1. The busbar shall be installed at the base and back of each cabinet/rack for floor fed cabinets/racks.
 2. The busbar shall be installed at the top and back of each cabinet/rack for top fed cabinets/racks.
 3. Each cabinet and rack shall be provided with a minimum # 6 AWG ground wire.
 4. Do not loop from cabinet/rack to cabinet/rack.
 5. Each cabinet or rack bay against the wall shall be bottom/side ground fed from the wall.
 - a) Wall ground feeds/raceways to racks shall not be exposed on the walls.
 - b) Exception: Some cabinet or rack bays will require the ground to be fed from the ceiling raceway.
 6. All ground raceways within each cabinet/rack or cabinet base and adjacent-ganged cabinet base shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.
- H. Cable Runway, Cable Raceway and Support System Grounding
1. The Contractor shall provide communications cable tray and cable runway systems with a communications dedicated ground from the TGB.
 2. All cable tray needs to be electrically continuous per NEC 250.96.
 - a) Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an

alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current plausibly to be imposed on them.

- b) Any nonconductive paint, enamel, or similar coating shall be removed at the threads, contact points, and contact surfaces.
 - c) Grounding or bonding conductors shall be connected by fittings designed for that purpose to ensure adequate bonding.
- 3. The Contractor shall provide and install a #6 AWG ground wire to bond one end of each cable tray/runway system to the TGB.
 - 4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to the nearest TGB with grounding bushings or ground clamps.
- I. Shielded Backbone Cabling
 - 1. The Contractor shall terminate and bond the shield to the nearest TGB or TMGB at both ends, following manufacturer's guidelines.

1.12 FIELD QUALITY CONTROL

- A. Testing
 - 1. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc.
 - 2. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
 - 3. If stray currents, shorts, etc., are detected, eliminate or correct as required.

END OF SECTION 27 05 26

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

GENERAL

1.1 SUMMARY

A. Section Includes

1. Hangers and Supports, including open-top supports (cable hooks) for communications systems.
2. Conduits and Pull Boxes for communications systems.
3. Cable Tray and Cable Runway with associated accessories and fittings for communications systems.

B. Related Sections

1. Section 260000 Electrical (including related sub-sections)
2. Section 270000 Communications Systems
3. Section 270526 Grounding and Bonding for Communications Systems
4. Section 271100 Communications Equipment Room Fittings
5. Section 271300 Communications Backbone Cabling
6. Section 271500 Communications Horizontal Cabling
7. Section 274100 Audio-Visual Systems

1.2 REFERENCES

- A. The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 1. Refer to Section 270000.
- D. Codes and Standards
 1. Refer to Section 270000.

1.3 SUBMITTALS

- A. Refer to Section 270000.

1.4 QUALITY ASSURANCE

- A. Refer to Section 270000.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 270000.
- B. Conduit Storage
 1. Package conduits in bundles maximum 10'-0" long, with conduit and coupling thread protectors for indoor/outdoor storage.
 2. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage.
 3. Protect coating on plastic-coated rigid conduit, fittings, and bodies from damage during shipment and storage.
 4. Store conduit above ground on horizontal racks to prevent corrosion and entrance of debris.

5. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Protect plastic conduit and inner duct from sunlight. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

PRODUCTS

1.6 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:
- B. Cable Hooks
 1. Cooper B-Line, Inc.
 2. Erico
 3. Caddy
 4. Owner approved alternate
- C. Cable Tray
 1. Cooper B-Line, Inc.
 2. Chatsworth (CPI)
 3. Hoffman
 4. WBT Wire Mesh
 5. Owner approved alternate
- D. Wire Basket Cable Tray Cutting Tool
 1. Flex Tray
 2. Owner approved alternate
- E. Polyethylene Cable Support System
 1. Erico
 2. Owner approved alternate
- F. Innerduct
 1. Carlon Riser Guard Flexible Raceway (corrugated innerduct)
 2. MaxCell (fabric innerduct)
 3. Owner approved alternate
- G. Measured pull tape (pull tape printed with sequential footage markings)
 1. Fibertek
 2. Condux International
 3. Owner approved alternate
- H. Labeling
 1. Refer to Section 270000.
- I. Firestopping
 1. Refer to Section 270000.

1.7 CABLE HOOKS

- A. Cable hooks shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
- B. Features
 1. Cable hooks shall have a flat bottom and provide a minimum of 0'-1.625" cable-bearing surface.
 2. Cable hooks shall have 90° radius edges to prevent damage while installing cables.
 3. Cable hooks shall be designed so that the mounting hardware is recessed to prevent cable damage.

4. Cable hooks for non-corrosive areas shall be pre-galvanized steel. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish.
 5. Cable hooks for corrosive areas shall be stainless steel.
 6. Cable hooks shall have a stainless-steel cable latch retainer to provide containment of cables within the hook.
 7. The retainer shall be removable and reusable.
- C. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.
- D. Load cable hooks in accordance with manufacturer requirements and recommendations.
- E. Provide capacity for 20% growth, add additional hooks as needed.
- 1.8 PULL BOXES, JUNCTION BOXES, AND GUTTERS
- A. All junction boxes, gutters and pull boxes shall be UL listed and comply with NEC requirements.
- B. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
1. 16-gauge steel or heavier
 2. Seams shall be continuously welded and grounded smooth
 3. External screws and clamps
 4. External mounting feet (where applicable)
 5. Oil-resistant gasket and adhesive
 6. ANSI 61 gray polyester powder coating inside and out over phosphatized surface
- C. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.
- D. All junction boxes, gutters and pull boxes shall be securely installed.
- 1.9 CONDUITS
- A. All conduits shall be UL listed and comply with NEC requirements.
- B. Conduit Fittings
1. All fittings shall be compression or threaded.
 2. Fittings shall provide a secure connection for pulling communications cables.
 3. Setscrew fittings are not permitted.
 4. Conduit "condulets" are not permitted.
- C. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.
- D. Innerduct:
1. All fiber shall be installed in innerduct unless fiber cabling is armored.
 2. Shall be constructed of non-metallic material.
- E. Only manufacturer's fittings, transition adapters, terminators and fixed bends shall be used.
- F. Measured Pull Tape
1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
 2. Minimum average tensile strength shall be 1130 lbs. for 0'-1.5" and smaller conduits and innerduct.
 3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0'-1.5".
- G. Fill and Bend Radius
1. Conduit fill shall comply with NEC requirements.
 2. The minimum bend radius is 6 X the conduit inside diameter (ID) for 0'-2" conduit or less.
 3. The minimum bend radius is 10 X the conduit ID for a conduit greater than 0'-2".
 4. There shall be no more than two 90° bends (180° total) between conduit pull boxes.

5. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
6. Do not use pull boxes for direction changes unless specifically designated otherwise in the drawings.
7. Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.

H. Routing

1. Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
2. There shall be no continuous conduit sections longer than 100'-0" for premises conduits. For runs that total more than 100'-0", insert junction or pull boxes so that no continuous run between pull boxes is greater than 100'-0".

I. Penetrations

1. All conduit penetrations shall comply with all applicable fire codes.
2. All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.

1.10 CABLE TRAY

- A. Cable tray systems are defined to include, but are not limited to, straight sections of cable trays, bends, tees, elbows, reducers, crosses, wyees, vertical bends, up/down tees, cable support fittings, drop-outs, supports and accessories.
- B. Install all tray types utilizing manufacturer recommended installation instructions and applicable standards.
- C. Load cable tray and cable runway in accordance with manufacturer requirements and applicable standards.
- D. Cable Tray Materials
 1. Aluminum
 2. Pre-galvanized Steel
 3. Hot-dip Galvanized Steel
 4. Stainless Steel
 5. Yellow Zinc Dichromate
 6. Pre-Galvanized Zinc
 7. Electro-Galvanized Zinc
- E. Cable Tray Systems
 1. Wire basket (mesh) of types and sizes indicated on the drawings; with connector assemblies, clamp assemblies, connector plates, splice plates, cable drop outs, bonding accessories, and splice bars. Construct units with rounded edges and smooth surfaces.
 2. Continuous mesh polyethylene cable-support system: with connector assemblies and appropriate support components. All parts shall be UL-listed. Plastic (non-metallic) parts shall have a zero-detectable halogen content as substantiated by an independent test laboratory.
 3. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 0'-9" on center. Spacing in radius fittings shall be 0'-9" as measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 0'-.875" with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
 4. Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails.
 5. Solid bottom trough type trays shall consist of two longitudinal members welded to the side rails.

- F. Cable trays shall have sufficient depth and width so as not to exceed a maximum 50% fill ratio, including 20% capacity for anticipated growth.
- G. All straight sections shall be supplied in minimum 8'-0" lengths, except where shorter lengths are permitted to facilitate tray assembly lengths.

1.11 HANGERS AND SUPPORT

- A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 lbs with a safety factor of 3.
- B. Steel support brackets shall have a removable galvanized steel retaining strap.
- C. Steel support brackets shall accept 0'-3/8" (10mm) threaded rod for attachment to building structure or sub structure.

EXECUTION

1.12 EXAMINATION

- A. Refer to Section 270000.

1.13 PREPARATION

- A. Refer to Section 270000.
- B. Verify system is properly sized for cables before installation.
- C. Verify that the manufacturer recommended loads are not exceeded.
- D. Verify general routing and coordinate locations with other trades before installation. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to ensure non-interference from other trade installations.

1.14 INSTALLATION

- A. Refer to Section 270000.
- B. Cable Hooks
 1. Provide cable hook (j-hook) cable support system for horizontal and/or riser cabling in accessible ceiling space. Assemblies shall be complete with mounting hardware.
 2. Provide threaded rod for supporting hangers when hanging from floor deck and deck members.
 3. Follow manufacturers fill capacities.
 4. Locate cable hooks on 4' to 5' centers to adequately support and distribute the cable's weight.
 5. Suspended cables shall be installed with at least 0'-3" of clear vertical space above the ceiling tiles and support channels.
 6. For larger quantities of cables, provide special supports that are specifically designed to support the required cable weight and volume.
 7. Do not support pathways or cables with the ceiling suspension system or use electrical, plumbing, or other pipes for support.
 8. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported.
 9. Secure and support exposed horizontal cable at intervals not exceeding 5'-0" and not less than 1'-4" (16") from cabinets, pack pole, boxes, fittings, outlets, racks, frames, and terminals.

10. Cable sag between vertical supports for horizontal pathway shall not exceed 0'-6". Provide at least 0'-3" cable sag between supports.
 11. Painted J-hooks shall meet or exceed NEC requirements for the environment in which the product is installed.
- C. Conduit and Pull Boxes
1. The Contractor shall route the conduit in approximate locations unless drawing is dimensioned for precise placement.
 2. Conduit cuts shall be square. Ream ends of burrs and remove metal shavings and cutting lubricants before conduit is connected to the conduit system.
 3. For conduit embedded in concrete, coat threaded connections in conduits with colloidal rust and corrosion inhibitor and sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured.
 4. Cap unused conduits with watertight caps
 5. Make conduit connections with appropriate fittings and tighten securely.
 6. Use appropriate tools to install PVC coated conduit; avoid damage to exterior coating.
 7. Install liquid-tight flexible metal conduit where exposed to weather, water, or other liquids.
 8. Use IMC, PVC conduit, or rigid galvanized steel conduit in underground installations.
 9. The Contractor shall provide fabric innerduct in all underground conduits, as indicated on the drawings.
 - a) The Contractor shall use pre-lubricated, woven polyester, low friction, and high abrasion resistant fabric.
 - b) The Contractor shall be trained for proper installation technique by the innerduct manufacturer. The Contractor shall coordinate with the owner to demonstrate that pull ropes in each inner duct cell move freely from end to end.
- D. Cable Tray and Cable Runway
1. Cut wire basket tray members square with approved cable tray cutting tool as to not leave sharp edges at cut point. Remove burrs and smooth the ends before the cut is connected to wire-mesh tray system.
 2. Ensure that standard splices are designed to have less than 1 milliohm (0.0001 Ω) of resistance between connections and provide bonding between sections. Painted wire mesh tray requires the outer mask of the non-conductive surface be removed at each end of the tray prior to installing the splice to provide continuity between painted tray sections.
 3. Threaded rod (minimum 0'- $\frac{1}{2}$ " diameter) or equivalent and slotted channel shall be used for hanging cable tray between floor deck and deck members
- E. Fiber Support:
1. Support vertical fiber optic cable with basket weave wire/cable grips. Support fiber riser with single weave support grip with a single offset eye.
 2. Mount/attach pulling eye to a wall or ceiling deck secured hook to support/provide strain relief to riser cable. Provide a minimum 3'-0" loop of fiber prior to entering fire stopped floor sleeve.
 3. Where required coil up slack fiber cable into pull box and secure with single weave support grip.
- F. Clearances
1. A minimum of 1'-0" access headroom shall be provided above a cable tray. Ensure that other building components do not restrict access to the cable trays from the sides.
 2. Power outlets shall not be installed in or mounted to cable tray or cable runway.
 3. Provide 3'-0" of unencumbered space for every 10'-0" segment of tray.
 4. Cable tray clearances
 - a) Motors or transformers: 4'-0"
 - b) Power cables and conduit: 1'-0"
 - c) Fluorescent lighting: 0'-5"
 - d) Halide lights: 1'-0"

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- e) Above the ceiling tiles: 0'-3"
- f) Access above and on one side of the cable tray: 1'-0"

1.15 FIELD QUALITY CONTROL

- A. Test system to ensure electrical continuity of bonding and grounding connections.
- B. Ensure compliance with specified maximum ground resistance.
- C. Refer to NFPA 70B Chapter 18 for testing and test methods.

1.16 CLEANING

- A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
- B. Wipe clean all cable trays and apply appropriate manufacturer's paint to areas that have been scratched.

END OF SECTION 27 05 28

SECTION 27 11 00 - COMMUNICATIONS ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes basic communications and equipment room design requirements and fittings including:
 - 1. Equipment cabinets, racks, frames and enclosures
 - 2. Cable management and ladder racks
 - 3. Telecommunications service entrance pathways
 - 4. Rack mounted power protection and power strips
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271300 Communications Backbone Cabling
 - 6. Section 271500 Communications Horizontal Cabling
 - 7. Section 274100 Audio-Visual Systems

1.2 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to section 270000.
- D. Codes and Standards (Most recent editions or as required in contract)
 - 1. ANSI/TIA-568-C: Commercial Building Telecommunications Infrastructure Standard
 - 2. ANSI/TIA-569-D: Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. ANSI/TIA-606-C: Administration Standard for Commercial Telecommunications Infrastructure
 - 4. ANSI/NECA/BICSI-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 5. TIA-758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
 - 6. National Electrical Code (NEC), based upon year approval by local codes or AHJ
 - 7. BICSI Telecommunications Distribution Methods Manual (TDMM)
 - 8. Local, county, state and federal regulations and codes in effect as of date of purchase
 - 9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 COMMUNICATIONS ROOMS

- A. Communications rooms must be dedicated to designated equipment and services:
 - 1. Space shall not be used for storage of equipment not related to designated equipment and services.
 - 2. Hazardous or corrosive materials shall not be stored in the space.

3. Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.
 - a) Foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases shall not be installed or pass through communication rooms.
 - b) With the exception of fire sprinklers, all water pipes shall be routed around communications room.
- B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.
- C. Walls shall be covered with 0'- $\frac{3}{4}$ " X 4'-0" X 8'-0" AC-grade plywood backboard 1'-0" AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment.
 1. Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 0'-1", are spaced not greater than 1'-6" (18") apart in each stud, and with screws 0'-0" from the top and bottom of plywood.
 2. Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint.
 3. If applicable fire-treatment verification stamps on plywood shall be left unpainted to be readable.
- D. Communications room walls shall extend from floor slab to ceiling deck, with no drop ceilings installed.
- E. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.
- F. Cable ladder rack should be used to distribute cables within rooms, complete with cable bend limiters (drop outs).
- G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.
- H. Communications rooms shall have only one lockable entrance door, a minimum of 3'-0" wide and 7'-0" high, that opens towards the outside of the room, and does not open into another room.
 1. Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.
 2. Doors should have no windows or door seals.
 3. Communications rooms should have no exterior identifying markings.
- I. Mechanical
 1. Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.
 2. Provide ventilation in the communications rooms to dissipate heat generated by active devices.
 3. Temperature and Humidity requirements:
 - a) Maintain communication rooms at an average of 60°F to 70°F, with a relative non-condensing humidity of 30% to 50%.
 - b) The temperature range should be maintained within $\pm 9^\circ$
- J. Plumbing
 1. If "wet" fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.
 2. Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.
 3. Drainage troughs are also recommended for leakage protection.

K. Electrical

1. One manufacturer's product is recommended for each type of installation. The mixing of different manufacturer products for one item is not acceptable.
2. No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.
3. The Contractor shall install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc.). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.
4. The Contractor shall provide uniform illumination of at least 50 foot-candles (fc) 3'-0" AFF for communications rooms located a minimum of 8'-6" AFF.
 - a) Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 1'-7" (19") standing racks.
 - b) Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks

1. 1'-7" (19") X 7'-0" relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.
 - a) The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.
 - b) Racks with active electronics shall have rack mounted power strips.

1.4 SUBMITTALS

- A. Refer to section 270000.

1.5 QUALITY ASSURANCE

- A. Refer to section 270000.

B. Product Standards

1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to section 270000.

- B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.7 PROJECT SITE CONDITIONS

- A. Refer to section 270000.

1.8 WARRANTY

- A. Refer to section 270000.

- B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer's warranty process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 1'-7" (19") Floor-Mounted Equipment Racks and Support Components
 - 1. Chatsworth (CPI)
 - 2. B-Line
 - 3. Owner approved alternate
- B. Horizontal Runway and Support Components
 - 1. Chatsworth (CPI)
 - 2. B-Line
 - 3. Owner approved alternate
- C. Horizontal Rack-Mount Cable Management
 - 1. CommScope
 - 2. Panduit
 - 3. Leviton
 - 4. Owner approved alternate
- D. Vertical Rack-Mount Cable Management
 - 1. CommScope
 - 2. Panduit
 - 3. Leviton
 - 4. Owner approved alternate
- E. Equipment Cabinet, Floor-Mounted
 - 1. Chatsworth (CPI)
 - 2. B-Line
 - 3. Owner approved alternate
- F. Equipment Cabinet, Wall-Mounted
 - 1. Chatsworth (CPI)
 - 2. B-Line
 - 3. Owner approved alternate
- G. Raised Floor Rack Support
 - 1. Chatsworth (CPI)
 - 2. B-Line
 - 3. Owner approved alternate
- H. Labeling
 - 1. Refer to section 270000.
- I. Firestopping
 - 1. Refer to section 270000.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Refer to Section 270000.

3.2 PREPARATION

- A. Refer to section 270000.

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- B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
- C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 INSTALLATION

- A. Refer to section 270000.

3.4 FIELD QUALITY CONTROL

- A. Refer to section 270000.

3.5 CLEANING

- A. Refer to section 270000.

3.6 ACCEPTANCE

- A. Refer to section 270000.

END OF SECTION 27 11 00

SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

GENERAL

1.1 SUMMARY

- A. This section includes the backbone cabling portion of a structured cabling system including:
 - 1. Copper backbone cabling
 - 2. Fiber backbone cabling
 - 3. Splicing
 - 4. Termination and patch cables
- B. Provide all backbone cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in Communications rooms.
- C. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271100 Communications Equipment Room Fittings
 - 6. Section 271500 Communications Horizontal Cabling
 - 7. Section 274100 Audio-Visual Systems

1.2 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to section 270000.
- D. Codes and Standards (Most recent editions or as required in contract)
 - 1. ANSI/TIA-568.0-D: Commercial Building Telecommunications Wiring Standard
 - 2. ANSI/TIA-569.1-D Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. ANSI/TIA-606-C: Administration Standard for Commercial Telecommunications Infrastructure
 - 4. ANSI/NECA/BICSI-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 5. TIA/EIA-758-C: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
 - 6. National Electrical Code (NEC), based upon year approval by local codes or AHJ
 - 7. BICSI Telecommunications Distribution Methods Manual (TDMM)
 - 8. Local, county, state and federal regulations and codes in effect as of date of purchase
 - 9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 SUBMITTALS

- A. Refer to section 270000.
- B. Cable Pulling Plan

1. The contractor shall submit a cable pulling plan prior to installation.
 2. Submittal requirements:
 - a) Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
 - b) Indicate contents of each conduit.
 - c) Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
 - d) Include detail and schedule showing the construction sequence of communications rooms.
 - e) Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the engineer.
- C. Splice Plan
1. The contractor shall submit shop drawings indicating the intended cable splice points, mounting method and equipment list prior to installation
- D. Cable Testing Plan
1. Refer to Section 270000.
- E. Cable Testing Reports
1. Refer to Section 270000.
- 1.4 QUALITY ASSURANCE
- A. Refer to section 270000.
 - B. Cable splicing personnel shall have a minimum of five years splicing experience and shall have completed a minimum of five major splicing projects.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Refer to section 270000.
 - B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)
 - C. Fiber cables shall be shipped on reels in lengths as specified with a minimum overage of 10%:
 1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
 2. Two meters of cable at both ends of the cable shall be accessible for testing.
 - a) All fiber shall be tested on the reel for continuity and distance compliance before installation.
 3. Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture.
 - a) Labels shall be water resistant and the writing on the labels shall be indelible.
- 1.6 PROJECT SITE CONDITIONS
- A. Refer to section 270000.
- 1.7 WARRANTY
- A. Refer to section 270000.

PRODUCTS

- 1.8 ACCEPTABLE COPPER MANUFACTURERS
- A. Backbone (Riser) cable
 1. CommScope
 2. Owner approved alternate

- B. Plenum rated cable
 - 1. CommScope
 - 2. Owner approved alternate

1.9 ACCEPTABLE FIBER CABLE MANUFACTURERS

- A. Backbone (Riser) cable
 - 1. Corning
 - 2. Owner approved alternate
- B. Plenum rated cable
 - 1. Corning
 - 2. Owner approved alternate
- C. Armored & Plenum rated cable
 - 1. Corning
 - 2. Owner approved alternate

1.10 ACCEPTABLE COMPONENT MANUFACTURERS

- A. Fiber Connectors, (LC)
 - 1. Corning
 - 2. Owner approved alternate
- B. Fiber Duplex Patch Cables (Type SM and MM)
 - 1. Corning
 - 2. Owner approved alternate
- C. Fiber adapter panels (6-port)
 - 1. Corning
 - 2. Owner approved alternate
- D. Fiber Termination Shelf (Rack-Mounted)
 - 1. Corning
 - 2. Owner approved alternate
- E. Fiber Distribution Cabinet (Wall Mounted)
 - 1. Corning
 - 2. Owner approved alternate
- F. Building Entrance Terminals – 110in/110out – complete with 5 pin fast acting solid state protection modules for all terminated cable pairs.
 - 1. Circa
 - 2. Portasystems
 - 3. Emerson
 - 4. Owner approved alternate
- G. Labeling
 - 1. Refer to section 270000.
- H. Firestopping
 - 1. Refer to section 270000.

1.11 FIBER BACKBONE CABLING

- A. Fiber General Requirements
 - 1. Fiber shall be certified to meet all parts of TIA-455 and comply with TIA-492, ANSI/ICEA S-83-596 and ANSI/ICEA S-83-640 and the NEC.
 - 2. Fibers shall have D-LUX coating or approved equivalent to ensure color retention, minimize micro bending losses and improve handling. The coating shall be mechanically strippable.

3. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP (optical fiber non-conductive plenum) in accordance with the NEC.
 - a) Plenum Fiber rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket.
 - i) Each group of fibers shall have a color-coded Low Smoke PVC buffer.
 - ii) The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded low smoke tube.
 - b) Within the premises, all fiber shall be placed in plenum rated innerduct the entire length of the cable for protection. Use manufacturer plenum rated couplings for all connections.
 4. Riser cable shall meet UL 1666 and be marked OFNR (optical fiber nonconductive riser) in accordance with the NEC.
 - a) Non-plenum, riser rated cable consisting of multiple fibers, shall have an orange, Polyvinyl Chloride (PVC) outer jacket.
 5. OSP (Outside Plant) Fiber
 - a) Stranded loose tube dielectric fiber cable shall be utilized for underground conduit, direct buried, or aerial applications.
 - b) Underground cable, including cable installed in conduits or duct banks, shall contain an additional moisture barrier in the form of a flooding compound.
 - c) All OSP fiber strength members shall be dielectric without any metallic elements.
 6. Fiber conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the following color codes:
 - a) Fiber/Binder No. 1 – blue
 - b) Fiber/Binder No. 2 – orange
 - c) Fiber/Binder No. 3 – green
 - d) Fiber/Binder No. 4 – brown
 - e) Fiber/Binder No. 5 – slate
 - f) Fiber/Binder No. 6 – white
 - g) Fiber/Binder No. 7 – red
 - h) Fiber/Binder No. 8 – black
 - i) Fiber/Binder No. 9 – yellow
 - j) Fiber/Binder No. 10 – violet
 - k) Fiber/Binder No. 11 – rose
 - l) Fiber/Binder No. 12 – aqua
 7. Cable Minimum Bending Radius:
 - a) During Installation: 20X cable diameter
 - b) After Installation: 10X cable diameter
 8. Operating temperature range: -76°F to 185°F (-60°C to 85°C)
- B. Multi-mode Fiber Requirements
1. Fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.
 2. 50/125 $\mu\text{m} \pm 2.5 \mu\text{m}$ core (OM2, OM3 & OM 4)
 3. Core non-circularity: = 5%
 4. 125 $\mu\text{m} \pm 1 \mu\text{m}$ cladding diameter
 5. Cladding non-circularity: =1%
 6. Colored fiber diameter: 254 $\mu\text{m} \pm 7 \mu\text{m}$
 7. Buffering diameter: 890 $\mu\text{m} \pm 50 \mu\text{m}$
 8. Minimum tensile strength: 100,000 psi
 9. Maximum Attenuation: 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm
 10. Minimum Bandwidth: 2000 MHz per km with laser launch at 850 nm ensured by differential mode delay at 850 nm” in TIA-492AAAC and 500 MHz at 1300 nm.
 11. Additional component and transmission requirements for a 50/125 μm fiber cable capable of supporting 10 Gb/s serial transmission up to 984'-0" (300m) using 850 nm nominal

wavelength lasers. These cables are suitable for use in accordance with ANSI/TIA-568-B.1.

C. Single Mode Fiber Requirements

1. Fibers shall have dual wavelength capability, transmitting at 1310 and 1550 nm ranges.
2. 8.3 μm core
3. 125 $\mu\text{m} \pm 1 \mu\text{m}$ cladding diameter
4. Cladding non-circularity: = 1%
5. Core/cladding concentricity error: = .5 μm
6. Colored fiber diameter: 254 $\mu\text{m} \pm 7 \mu\text{m}$
7. Maximum Attenuation: 1.0 dB/km at 1310 and 1550 nm (inside premises) and 0.5 dB/km at 1310 and 1550 nm (OSP)
8. Minimum Bandwidth: 20 GHz
9. The mechanical and environmental specifications for OSP fiber cable shall be in accordance with ANSI/ICEA S-87-640. OSP fiber cables shall be of a water-block construction and meet the requirements for compound flow and water penetration as established by ANSI/ICEA S-87-640. Outdoor cable shall have minimum pull strength of 2670 N (600 lbf).

1.12 COPPER BACKBONE CABLING

A. Copper Cable Requirements

1. 100 Ω balanced twisted-pair
2. All cable installed shall be rated as appropriate to environment it is installed.
3. Plenum-rated cabling: Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked CMP (communications multipurpose plenum) in accordance with the NEC.
 - a) Plenum cable shall consist of #24-AWG solid copper conductors insulated with color-coded FEP
4. Non-plenum riser-rated cabling shall meet UL 1666 and be marked CMR (communications multipurpose riser) in accordance with the NEC, and shall consist of 24 AWG copper conductors insulated with color-coded PVC copper cables.
5. OSP rated copper cables shall be utilized for underground conduit.
 - a) ASP-filled multi-pair copper cables shall be utilized for direct buried applications.
 - b) All OSP copper cable shall be transitioned to inside cable within 50'-0" of building entry.
 - c) The metallic portion of the cables, if present, must be bonded to the building ground upon entry.
6. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

B. Coaxial Cable Requirements

1. All cable must be plenum-rated .500 hard line or RG-11
2. All cable shall be shielded, with a copper clad aluminum center conductor; expandable polyethylene dielectric; continuous aluminum outer conductor, and a flame retardant jacket.
3. All cable shall be tested and marked to comply with the NEC requirements for (CATVR) riser rating.

1.13 COPPER PATCH CABLES

- A. Refer to Section 271500.

1.14 FIBER PATCH CABLES

- A. Verify exact quantities and lengths with Owner prior to purchase
- B. Provide the appropriately-rated (matched to the installed cable plant) Modular Patch Cords for the appropriate location and equipment.

- C. Multi-mode patch cables shall be a buffered, graded-index fiber with a 50 μm core and a 125 micron cladding
- D. Single Mode patch cables shall be a stepped-index 8.3 μm core with a 125 μm cladding.
- E. Duplex ST connectors shall meet the following specifications:
 - 1. Made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.
 - 2. Patch cords shall be in original packaging when presented to the Owner.
- F. Aramid yarn and a jacket of flame-retardant PVC shall cover the fiber cladding.
- G. Multi-mode patch cables additional requirements:
 - 1. Mated Connector Loss: $\mu = 0.3 \text{ dB}$, $\sigma = 0.2 \text{ dB}$
 - 2. Connection Repeatability: 0.20 dB maximum changes per 100 reconnects
- H. Single Mode patch cable additional requirements:
 - 1. Return Loss: -50 dB maximum
 - 2. Mated Connector Loss: $\mu = 0.35 \text{ dB}$, $\sigma = 0.2 \text{ dB}$
 - 3. Connection Repeatability: 0.20 dB maximum changes per 200 re-connects.
- I. The Multi-mode connector (visible portion) and adapter/outlet shall be identified by the color beige.
- J. The Single Mode connector (visible portion) and adapter/outlet shall be identified by the color blue.

1.15 LABELING

- A. Refer to Section 271500.

EXECUTION

1.16 EXAMINATION

- A. Refer to Section 270000.
- B. Verify the following before proceeding:
 - 1. Conduits, cable trays and pull boxes are properly installed following section 270528
 - 2. Backboards in communications rooms are properly installed following section 271100
 - 3. Grounding system is properly installed and tested following section 270526
 - 4. Liquid-carrying pipes are not installed in or above voice and data system communications rooms.
 - a) Do not proceed with installation in affected areas until removed.

1.17 PREPARATION

- A. Refer to section 270000.

1.18 COPPER INSTALLATION

- A. Backbone Cable
 - 1. The Contractor shall install riser cables according to manufacturer's instructions for compliance to warranty requirements.
- B. Copper Cable and Connectors
 - 1. The Contractor shall install connectors according to manufacturer's instructions for compliance to warranty requirements.

1.19 TERMINATION FOR COPPER BACKBONE

- A. Copper

1. 110-type Wiring Blocks using C5 clips, Insulation Displacement Connector Systems, with proper patch cord
 - a) Compatible with all voice and data circuits
 - b) Underwriter's Laboratories (UL) listed
2. Protector Panels shall be provided for all outside plant installed copper circuits. The protectors shall provide pair-for-pair protection and be mounted on a 0'- $\frac{3}{4}$ " fire-rated wallboard.

1.20 FIBER INSTALLATION

A. Fiber Cable Installation

1. Fiber cable shall be installed in innerduct from near end termination point to far end termination point.
 - a) Only UL-approved plenum-rated innerduct shall be installed in all plenum areas.
 - b) Metallic conduit may be used in lieu of innerduct in plenum-rated ceilings if it is bonded and grounded correctly.
2. Only technicians certified by the product manufacturer shall perform terminations.
 - a) Terminations shall be made in a controlled environment.
 - b) Cables may be assembled off-site, although testing must be completed with the cable in its final installed condition.
 - c) Test optical fiber on the reel for distance and continuity verification before installation.
3. At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags.
 - a) These tags shall be yellow or orange in color and shall contain the warning "CAUTION FIBER OPTIC CABLE".
 - b) The text shall be permanent, black, block characters, and at least 0'-.1875" high.
 - c) A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5'-0".
 - d) Any section of exposed cable that is less than 5'-0" in length shall have at least one warning tag affixed to it.

B. Fiber Distribution Center

1. Contractor shall provide sufficient spare adapter plates to fill the appropriate-sized FDC.

1.21 FIBER TERMINATION AND SPLICING

A. Interconnect Units and Distribution Shelves

1. Modular in design and used in fiber interconnection, cross-connection, and splicing applications
2. 1'-7" (19") rack-mountable
3. Accept 12-strand, 24-strand, 48-strand or 72-strand terminations
4. Owner approved industry standard connector

B. Splicing and closures

1. Fiber splice modules shall be utilized for all OSP terminations.
2. The link shall consist of:
 - a) Fiber cable
 - b) Splice
 - c) Splice tray holder/closure
 - d) Fiber panel/coupler
 - e) Pre-manufactured fiber pigtail with pre-polished fiber connector
 - f) Fiber jumper to connect the pigtail-coupled link to the appropriate electronic switch

C. Fiber Fusion Splice

1. Fusion splices shall be mounted in protective trays within the closure.

2. Fusion splices shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/TIA-455-34, Method a (factory testing) or ANSI/TIA-455-59 (field testing).
 - a) Fiber splices shall have a minimum return loss of 20 dB for Multi-mode
 - b) Fiber splices shall have a minimum return loss of 26 dB for Single Mode
 - 1) Minimum Single Mode return loss for broadband analog video (CATV) applications is 55 dB.

1.22 INSTALLATION REQUIREMENTS

- A. All installation shall be done in conformance with ANSI/TIA-568-B standards, BICSI methods, and industry standard installation guidelines.
 1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.
 2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
 3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
- B. The Contractor shall provide service loops for cables terminating in the communications rooms.
 1. A 10'-0" service loop shall be provided and secured in a neat and standards-compliant manner above the equipment racks or cable trays unless specified otherwise.
 2. This allows for future changes or expansion without installing new cables.
- C. Documentation
 1. All cable inventory data documentation shall be submitted in format coordinated with and approved by owner so that data can be incorporated into existing databases.
 2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
 3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.

1.23 FIELD QUALITY CONTROL

- A. Refer to section 270000

1.24 COPPER POST-INSTALLATION TESTING

- A. Contractor shall test each pair or strand of every cable prior to acceptance.
- B. Refer to Sections 270000 and 271500
- C. Copper Test Documentation
 1. Refer to Section 271500
- D. Copper testing requirements
 1. Refer to Section 271500.
 2. Copper backbone shall exceed ANSI/TIA-568-B.2 Backbone Cabling requirements and meet the manufacturer's specifications for the installed product.
 - a) A far-end device shall be used for all frequency measurements.
 - b) The loss at 138 kHz shall not exceed 46 dB.
 - c) The test set shall have the ability to store 100 tests and be able to upload to a PC.
 - d) The test set shall be able to measure resistance between the following conductors: tip to ring, tip to ground, and ring to ground.
 - e) All measurements shall be greater than 999 Ω .
- E. Copper Test Equipment
 1. Refer to Section 271500.

1.25 FIBER POST-INSTALLATION TESTING

- A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete and proper test measurements of the installed fiber cabling.
- B. Contractor shall have successfully attended a fiber testing training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof.
- C. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing.
 - 1. Any testing performed on incomplete systems shall be redone on completion of the work.
- D. Dust caps shall be placed on fiber endfaces or adapters for each optical fiber link after all testing is complete on the fiber link.
- E. Pre-test Submittals
 - 1. Manufacturers catalog sheets and specifications for the fiber cable field-test instruments including
 - a) OLTS (Optical Loss Test Set)
 - b) OTDR (Optical Time Domain Reflectometer)
 - 2. A schedule (list) of all fiber cables to be tested
 - 3. Fiber testing training program certificate
 - 4. Sample test reports
- F. Fiber testing standards
 - 1. The Contractor shall meet or exceed the following standards and guidelines:
 - a) ANSI/TIA-568-C.0 Optical Fiber Transmission/Test Requirements, and Annex E: Optical Fiber Field Test Guidelines (Tier 2)
 - 1) Tier 2 testing is a higher level of testing that provides qualitative measures of the installed condition and performance of the cabling system
 - b) ANSI/TIA-568-D.3 Optical Fiber Cabling Components Standard
 - c) TIA/TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
 - 2. Multi-mode requirements
 - a) ANSI/TIA-526-14-A, Method B
 - b) ANSI/TIA-455-50B
 - 3. Single Mode requirements
 - a) ANSI/TIA-526-7, Method A.1: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7
 - 4. The cable installers shall have a copy of these references in their possession and be familiar with the contents
- G. In order to conform to the overall project event schedule, the contractor shall survey and coordinate the optical fiber testing with other applicable trades.
- H. In addition to the test regiment detailed in this document, the contractor shall notify the Owner of any additional tests that are deemed necessary to guarantee a fully functional system.
 - 1. The contractor shall carry out and record any additional measurement results at no additional charge.
- I. The contractor shall provide all test measurement results two (2) weeks prior to substantial completion in spreadsheet format and native file format from the test instrument.
 - 1. Software shall also be provided to view the native results.
- J. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
 - 1. A visible fault locator (VFL) normally uses a Class 2 or 3 light source and should not be directly viewed.

2. Safe usage of the tool requires indirect viewing of the light source by pointing the end of the fiber at an adjacent surface (or introducing another surface in front of a fixed mounted connector) until the presence of light is determined.
- K. Link attenuation measurement and allowance calculation
1. The measured link attenuation shall be less than the link attenuation allowance. The link attenuation allowance is calculated as:
 - a) Link Attenuation Allowance (dB) = Cable Attenuation Allowance (dB) + Connector Insertion Loss Allowance (dB) + Splice Insertion Loss Allowance (dB)
 - i) Connector Insertion Loss Allowance (dB) = Number of Connector Pairs X 0.4dB
 - ii) Splice Insertion Loss Allowance (dB) = Number of Splices X 0.15dB
 - iii) Cable Attenuation Allowance (dB) = Maximum Cable Attenuation Coefficient (dB/km) X Length (km)
- L. Fiber Testing Requirements
1. All installed fiber links shall be field-tested and pass the following tests:
 - a) OLTS (Optical Loss Test Set) length and dual wavelength attenuation
 - b) OTDR (Optical Time Domain Reflectometer) traces and event tables
 2. OLTS (Optical Loss Test Set)
 - a) The length and attenuation of each installed fiber link shall be measured and documented.
 - b) System loss measurements requirements:
 - i) 850 and 1300 nanometers for Multi-mode
 - ii) 1310 and 1550 nanometers for Single Mode
 - c) Reflective events (connections) shall not exceed 0.75 dB.
 - d) Non-reflective events (splices) shall not exceed 0.3 dB.
 - e) The acceptable link attenuation for Multi-mode horizontal fiber is based on the maximum distance of 295'-0".
 - f) A horizontal link in a network with a consolidation point may be tested using a fixed upper limit for attenuation of 2.75 dB.
 - g) Optical sources shall be turned on for a minimum of 5 minutes prior to referencing.
 - h) Fiber links shall be measured and reported for attenuation in each direction and attenuation bi-directionally (averaged in both directions)
 - i) Polarity shall be verified for duplex connector systems
 - j) Mandrels
 - 1) Mandrels shall be used when testing attenuation of Multi-mode fiber cabling
 - 2) Where mandrels are used, secure the mandrel to the light source by some means such as a cable tie or tape.
 - 3) Care should be taken to ensure that the fiber jacket is not deformed or damaged when using a cable tie or tape.
 - 4) The light source shall be referenced to the meter a minimum of twice daily (i.e., in the morning and noon).
 3. OTDR (Optical Time Domain Reflectometer)
 - a) An OTDR trace shall be taken of each fiber link in one direction to ensure uniformity of cable attenuation and connector insertion loss
 - b) Testing shall consist of a bi-directional end to end OTDR trace performed per TIA 455-61
 - c) Individual connector, splice and fiber insertion loss shall be evaluated using the OTDR trace.
 - d) Fibers shall be inspected at 250X for Multi-mode and 400X for Single Mode
 4. Maximum Attenuation
 - a) Single Mode ISP (inside) 1.0 dB/km at 1310 nm and 1550 nm

- b) Single Mode OSP (outside) 0.5 dB/km at 1310 nm and 1550 nm
- c) Multi-mode 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm
- 5. Test Cords (Jumpers)
 - a) Testing of the cabling shall be performed using high-quality test cords of the same fiber type and core size as the cabling under test. Use a single patch cord reference for fiber testing.
 - i) OLTS test cords shall be between 3'-3" (1m) and 16'-4" (5m).
 - ii) OTDR testing shall be approximately 328'-0" (100m) for the launch cable and at least 82'-0" (25m) for the receive cable. OTDR testing shall be Bidirectional with Pigtails installed.
 - b) The test jumper, the adapters, and fiber under test shall be cleaned immediately prior to each fiber being tested.
 - i) After cleaning, cleaning solutions shall be given sufficient time to evaporate (approximately 30 seconds) prior to the mating of fiber test jumper to the fiber under test.
- 6. Test Failure
 - a) Any fiber link that fails these requirements shall be diagnosed and corrected.
 - b) Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link meets performance requirements.
- 7. Acceptable Testers
 - a) Fluke DTX Cable Analyzer
 - b) Owner Approved equivalent
- M. The Owner or the Owner's representative shall be invited to witness, review or both witness and review field-testing.
 - 1. The Owner or the Owner's representative shall be notified of the testing start date, five (5) business days before testing commences.
 - 2. The Owner or the Owner's representative will select a random sample of 5% of the installed links and test that sample.
 - a) The measured results obtained from the random sample shall be compared to the data provided by the contractor.
 - b) If more than 2% of the sample results differ in terms of the pass/fail determination, the contractor under supervision of the Owner or Owner's representative shall repeat 100% of the testing at no cost to the Owner.
- N. Test Results
 - 1. The detailed test results documentation data is to be provided in an electronic database for each tested fiber strand and shall contain the following information:
 - a) Identification of the customer site as specified by the end-user.
 - b) Name of the test limit selected to execute the stored test results.
 - c) Name of the personnel performing the test.
 - d) Date and time the test results were saved.
 - e) The manufacturer, model and serial number of the test instrument.
 - f) The version of the test software and the version of the test limit database held within the test instrument.
 - g) Fiber identification number
 - h) Length for each optical fiber
 - i) Index of refraction used for length calculation when using a length capable OLTS.
 - j) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
 - k) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
 - l) Length for each optical fiber as calculated by the OTDR.

- m) Overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.
- n) Circuit IDs reported by the test instrument should match the specified label ID.

1.26 CLEANING

- A. Refer to section 270000.

1.27 ACCEPTANCE

- A. Refer to Section 271500.

END OF SECTION 27 13 00

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

GENERAL

1.1 SUMMARY

- A. This section of the horizontal cabling portion of a structured cabling system includes:
 - 1. UTP Copper cabling
 - 2. Termination and patch cables
- B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.
- C. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271100 Communications Equipment Room Fittings
 - 6. Section 271300 Communications Backbone Cabling
 - 7. Section 274100 Audio-Visual Systems

1.2 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to section 270000.
- D. Codes and Standards
 - 1. Refer to section 270000.

1.3 SUBMITTALS

- A. Refer to sections 270000 and 271300.

1.4 QUALITY ASSURANCE

- A. Refer to section 270000.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to sections 270000 and 271300.
- B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.6 PROJECT SITE CONDITIONS

- A. Refer to section 270000.

1.7 WARRANTY

- A. Refer to section 270000.

PRODUCTS

1.8 ACCEPTABLE MANUFACTURERS

- A. Labeling
 - 1. Refer to section 270000.
- B. Firestopping
 - 1. Refer to section 270000.

1.9 ACCEPTABLE COPPER MANUFACTURERS

- A. CAT 6 UTP Plenum Rated Cable
 - 1. CommScope or Uniprise, blue
 - 2. Owner approved alternate
- B. Data/Voice Outlet Components
 - 1. CommScope or Uniprise, blue for data
 - 2. Owner approved alternate
- C. Patch Panels (24 or 48 port)
 - 1. CommScope or Uniprise – 1 and 2 U
 - 2. Owner approved alternate
- D. Copper Patch Cords
 - 1. CommScope or Uniprise – 1 and 2 U Owner approved alternate
- E. Faceplates
 - 1. CommScope or Uniprise, 4 port, white
 - 2. CommScope or Uniprise, 2 port, white
 - 3. Wall phone faceplate, stainless-steel
 - 4. Owner approved alternate

1.10 ACCEPTABLE FIBER MANUFACTURERS

- A. Fiber Cable Plenum-rated
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate
- B. Fiber Connectors, (LC)
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate
- C. Fiber Termination Shelves and Cabinets (Rack-Mountable)
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate
- D. Fiber Distribution Cabinet (Wall Mounted)
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate
- E. Fiber adapter panels (6-port)
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate
- F. Fiber Duplex Patch Cables (Type SM and MM)
 - 1. Corning
 - 2. CommScope or Uniprise
 - 3. Owner approved alternate

1.11 ACCESSORIES

- A. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner.
- B. Provide clear plastic lamination serving each communication room.
- C. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

1.12 HORIZONTAL COPPER CABLING

- A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:
 - 1. Category 6 UTP cable
 - 2. Category 6A UTP cable
- B. Category 6 UTP Cable Requirements
 - 1. 23/24 AWG solid bare copper
 - 2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum)
 - 3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
 - 4. Cables shall be marked as UL verified with a minimum of Category 6 rating
 - 5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz) of analog broadband video
 - 6. The maximum horizontal cable length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295'-0".
 - 7. Cable shall meet or exceed the following electrical characteristics:
 - 8. Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications.

1.13 TERMINATION HARDWARE

- A. Patch panels
 - 1. Patch panels shall be rated to match installed cable plant
 - 2. The wiring block shall accommodate #23 AWG cable conductors.
 - 3. All modular cross connect panels shall be UL-listed.
- B. Work Area Outlet
 - 1. Universal eight-position jack pin/pair assignments
 - 2. Jack Color:
 - a) Data: Blue
 - b) VoIP: Green
- C. Work Area Outlet Faceplates:
 - 1. White or ivory to match electrical outlets.

1.14 PATCH CABLES

- A. Verify exact quantities and lengths with Owner prior to purchase
- B. Patch Cable requirements:
 - 1. Category 6, stranded UTP cable
 - 2. Standard modular non-keyed, 8-position 8-conductor plug
 - 3. 94V-0 rated
 - 4. UL listed
 - 5. Meets FCC Part 68

- C. Provide either a 3'-0", 5'-0", 7'-0", or 10'-0" Patch Cords at the communications room for each installed port.
 - 1. Coordinate with Owner on the active equipment layout prior to purchase to ensure correct sizing of patch cords from patch panels to switching equipment.
 - 2. When connecting voice ports to a copper riser, provide a one-pair stranded 8P8C connector on one end and 110GS on the other end and shall be of appropriate length for application.
 - D. Provide a 10'-0" Station Cord for each work area outlet port.
 - E. Place each size/length patch cord in a separate container, and mark the containers that hold the patch cords with the length of patch cords contained within.
 - F. All cords shall conform to the requirements of ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program.
 - G. Cords shall be equipped with an eight-pin modular connector on each end, wired straight through and shall be of appropriate length for application.
 - H. All rated patch cords shall be round, and consist of #23 AWG copper, stranded conductors, tightly twisted into individual pairs.
 - I. Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.
- 1.15 IDENTIFICATION (LABELING) SYSTEM
- A. Refer to sections 270000 and 271300.

EXECUTION

1.16 EXAMINATION

- A. Refer to Section 270000 and 271300.

1.17 PREPARATION

- A. Refer to section 270000.
- B. The Contractor shall check pathways, raceways, and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation prior to installation.

1.18 INSTALLATION REQUIREMENTS

- A. Refer to section 270000.
- B. All installation shall be done in conformance with ANSI/TIA-568-C standards, BICSI methods, industry standards and manufacturer's installation guidelines.
 - 1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.
 - 2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
 - 3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
- C. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.
 - 1. Pull cables in smooth and regular motions using methods that prevent cable kinking.

2. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
 3. If necessary, use approved cable pulling lubricant
 4. Use fish tape, cable, rope, basket weave wire/cable grips, and other tools that will ensure no damage to the media or raceway.
 5. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.
 6. Do not bend cable greater than a bend radius of 0'-1".
- D. Provide a 10'-0" service loop at the communications room and shall provide a 3'-0" service loop above the access ceiling or cable trays unless specified otherwise.
1. All service loops shall be a minimum of 1'-6" (18") in diameter and be accessible for maintenance.
- E. Coordinate loop placement and orientation with the technology consultant.
1. This allows for future changes or expansion without installing new cables.
- F. Install cables in continuous "home run" lengths from work station outlet to specified patch panel.
1. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the workstation outlet without written Owner permission.
- G. All cable must be handled with care during installation so as not to change performance specifications.
1. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable.
 2. There shall never be more than 0'-1/2" of unsheathed cable at either the wiring closet or the workstation termination locations.
- H. All cabling and associated hardware shall be placed so as to make efficient use of available space.
1. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.
- 1.19 CABLING METHODS
- A. The Contractor shall provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system.
1. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used.
 2. Use UL or ETL listed plenum rated cable in all spaces.
 3. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.
- B. Conceal raceway and cabling except in unfinished spaces as is practical.
- C. Exposed Cable
1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.
 2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist.
 - a) Owner must approve all exceptions.
- D. The Contractor shall utilize conduits/cable tray as indicated on the drawings.
- E. All cabling placed above drop ceilings must be supported by cable tray, J-hooks, caddy bags or conduit.
1. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported.
 - a) Attaching cable to pipes or other mechanical items is not permitted.
 - b) Cabling shall not be attached to ceiling grid wires.

2. Multiple cables are to be dressed every 5'-0" to 7'-0".
 - a) Maximum cable sag between cable hooks is 3"-6".
- F. The Contractor shall route data and voice cables separately in a neat and orderly fashion.
 1. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Cable ties shall be rated for the environment.
- G. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes.
- H. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts.
 1. Envelope will be removed on final trim out after other trades have completed their finish work.
 2. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
 - a) Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are on the floor.
 - b) Cable pulling force shall not exceed 25 lbs of pulling tension or cable manufacturer's recommended pulling tensions.
 - c) Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.
- I. Communications room cables shall be combed and dressed in a manner as to prevent twists, "braiding" and crossed cables in the cable bundle from the communication room entrance to the termination point at the rear of the patch panel.
 1. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.
 - a) Use Velcro wraps instead of cables ties for all bundling in the communications rooms.
 - b) Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the communications room.

1.20 CABLING SEPARATION

- A. Comply with TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.
- B. Maintain a minimum spacing of 1'-6" (18") from electrical feeders and/or branch circuit wiring including, but not limited to, light fixtures, sources of heat and EMI sources.
- C. Maintain a minimum spacing of 1'-0" from auxiliary systems cabling.
- D. Maintain a 1'-0" separation where cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems.
 1. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.
- E. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10'-0" is recommended.

1.21 CABLING TERMINATION

- A. Terminate cables in consistent consecutive order.
- B. Terminate cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.
- C. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

- D. Provide a 10'-0" service loop for horizontal cables at each rack in communications rooms.
 - 1. Locate loop at ceiling deck or on bottom of cable runway in minimum 1'-6" (18") diameter.
 - E. Provide a 3'-6" service loop for horizontal cables at work area outlets. Locate service loop above or below data/voice outlet where vertical cable run transitions to horizontal run.
 - F. Maintain twists in cable pairs to within 0'-½" of termination.
 - G. Video Surveillance Systems Cabling (Electronic Safety and Security <ESS> devices)
 - 1. Video Cameras will require a field terminated plug on the end of a horizontal cable to be directly plugged into device.
 - a) Follow TIA-862-A Building Automation Standard.
 - b) Contractor shall use applicable equipment in testing solid conductor plug.
 - 2. Group all security systems cables in one group.
 - 3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.
 - H. Building Systems Cabling (BAS, FA, elevator line, etc)
 - 1. Coordinate exact placement and connectivity requirements with applicable trade prior to installation.
 - 2. Group all building systems cables in one group.
 - 3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.
 - I. Limit cable-bending radius to 20X the cable diameter during installation, and 15X the cable diameter after installation.
 - J. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.
 - 1. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.
- 1.22 TERMINATION HARDWARE
- A. Station Hardware
 - 1. Flush mount jacks shall be mounted in a faceplate with back box.
 - 2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
 - 3. 8P8C Jack Pin Assignments for work area outlets shall match the T-568A wiring scheme.
 - B. Patch panels
 - 1. Copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels.
 - 2. All Modular jack panels shall match the T-568A wiring scheme.
 - C. Work Area Outlet
 - 1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA-568-C compliant for the specified transmission requirements.
 - D. Work Area Outlet Faceplates:
 - 1. Furnish and install blank plates in all unused ports.
- 1.23 SPECIAL CIRCUITS
- A. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits, including cables to wireless access point locations, security, elevators, fire alarms, etc.
 - B. Wireless Access Points
 - 1. Install two (2) cable(s) from dedicated wireless patch panel(s) in communications room to outlets having 8P8C connectors within a secure metal enclosure.
 - 2. Enclosures shall be NEMA rated for the environment to which they are exposed.
 - 3. 20'-0" of cable slack shall be coiled and hung on a "J"-hook at the enclosure location.

1.24 IDENTIFICATION AND LABELING

- A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.
- B. Fiber termination hardware (designation strip) shall have a 0'- $\frac{3}{4}$ " x 0'- $\frac{1}{4}$ " thermal transfer printable label with a permanent acrylic adhesive.
- C. 110-type copper termination hardware shall have a laser printable, non-adhesive label designed for 110 terminal block marking.
- D. All labels shall be permanent and shall not fade, peel, or deteriorate due to environment or time.
- E. The Contractor shall provide a copy of the finalized plan in writing to the Owner representative and DataCom Design Group for review and authorization to proceed.
 - 1. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.
- F. Labeling requirements:
 - 1. Label cable terminations on designation strips.
 - 2. Label all cable at each terminating point.
 - 3. Label each port of the work area outlet.
 - 4. Cable identification numbers shall not be duplicated.
 - 5. Label patch panels and wall mounted termination blocks in the communications rooms to match those on the corresponding voice and data outlets.
 - a) The font shall be at least 0'- $\frac{1}{8}$ " in height.
 - 6. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate labeling of grid with Owner and Architect prior to application of labels.
 - 7. Label each distribution rack, block and other terminating equipment unit and field within that unit within 0'-4" from the block or patch panel termination. Keep labels in a neat and orderly lineup.
 - 8. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms.
 - a) Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
 - 9. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.
- G. Location and termination field description
 - 1. Room location
 - 2. Rack-mount or Wall mount
 - 3. Termination field type
 - a) Specific patch panel ports versus a separate dedicated patch panel
 - b) 110-type
- H. Unique identifiers
 - 1. Segregation and position on equipment rack
 - 2. Port color-coding
 - 3. Unique labeling
- I. Documentation
 - 1. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
 - a) All labels shall correspond to as-built drawings and to final test reports.
 - 2. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.
 - 3. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.

4. Complete cross connect documentation is required.

1.25 FIELD QUALITY CONTROL

- A. Refer to section 270000.

1.26 POST-INSTALLATION TESTING

- A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)
- B. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.
- C. Standards Compliance and Test Requirements:
 1. Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.
- D. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.
 1. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.
 2. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.
 3. Length, propagation delay, and delay skew relative to the relevant limit.
 - a) Length, propagation delay, and delay skew shall be tested relative to the relevant limit.
 - b) Test shall also include mutual capacitance and characteristic impedance.
 - i) Any individual test that fails the relevant performance specification shall be marked as a 'FAIL'.
- E. Cable Test Documentation:
 1. Cable test documentation shall be submitted in hard copy and electronic formats.
 - a) If proprietary software is used, disk or CD shall contain any necessary software application required to view test results.
 - b) Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report.
 - c) Certificate shall reference traceable circuit numbers that match the electronic record.
 2. Each test record shall contain the cable ID as follows:
 - a) "MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #", e.g. MM-MC-HC23-001.
 3. Test results saved within the field-test instrument shall be transferred into an accessible database utility that allows for the maintenance, inspection and archiving of the test records.
 - a) These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test instrument".
 - b) The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
 4. Test reports shall include the following information for each cabling element:
 - a) Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
 - b) Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - c) Cable manufacturer, cable model number/type, and NVP
 - d) Tester make & model, serial number, hardware version, and software version.
 - e) Cable ID and project name
 - f) Auto-test specification used

- g) Overall pass/fail indication
- h) Date of test

F. Cable Test Equipment

1. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
3. Testing equipment shall be UL-verified to meet Level III accuracy.
 - a) The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
4. Testing equipment shall be within the calibration period recommended by the manufacturer.
5. Testing equipment shall have the latest software and firmware installed.
6. Testing equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.
7. Test adapter cables shall be approved by the manufacturer of the test equipment.
 - a) Adapter cables from other sources are not acceptable.
 - b) Adapter cables must be replaced after 1000 tests to ensure accuracy.
8. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
9. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
10. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
11. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
12. Test equipment must include a library of cable types, sorted by major manufacturer.
13. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
 - a) Test equipment must store at least 1000 auto tests in internal memory.
14. Test equipment must include DSP technology for support of advanced measurements.
15. Test equipment must make swept frequency measurements in compliance with TIA standards.
16. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector.
17. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
18. Acceptable testers:
 - a) Fluke DTX CableAnalyzer
 - b) Owner approved equivalent

1.27 FIBER TESTING

- A. Refer to Section 271300.

1.28 CLEANING

- A. Refer to section 270000.

1.29 ACCEPTABLE

- A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.
- B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

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- C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the “* PASS” (asterisk) will not be acceptable.
 - 1. These circuits must be repaired to meet “PASS”.

END OF SECTION 27 15 00

SECTION 27 41 13 – AUDIOVISUAL INFRASTRUCTURE

PART 1 GENERAL

A. SUMMARY

1. Devices in this Section are to be provided and installed by Division 26 Electrical Contractor.
2. Section Includes:
 - a) Floor Boxes
 - b) Flat Panel Display In-Wall Junction/Storage Boxes
 - c) Wall Mount Junction Boxes
 - d) Ceiling Mount Plates
 - e) Pull Boxes
 - f) Projection Screens

B. CONDITIONS AND REQUIREMENTS

1. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

C. APPLICABLE DRAWING SETS

1. AVI (Architecturally Integrated Infrastructure)

D. RELATED DRAWING SETS FOR COORDINATION

1. AVS Series (Audiovisual Systems and Equipment)
2. E Series (Electrical)

E. RELATED SECTIONS FOR COORDINATION

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 – General Requirements
3. Division 02 – Existing Conditions
4. Division 09 – Finishes – Walls, Ceilings and Floors
5. Division 11 – Equipment
6. Division 12 – Furnishings
7. Division 23 – Heating, Ventilating and Air Conditioning (HVAC)
8. Division 26 – Electrical
9. Division 27 – Communications
10. Division 28 – Electronic Safety and Security

F. SUBMITTALS

1. Comply with requirements of Division 01 – General Requirements – Submittal Procedures.
 - a) Product Data: For the following AV Infrastructure System components:
 - (1) Floor Boxes
 - (2) Flat Panel Display In-Wall Boxes
 - (3) Wall Mount Junction Boxes

- (4) Pull Boxes
- (5) Ceiling Mount Plates
- (6) Projection Screens

b) Shop Drawings: For the following AV Infrastructure System components. Include plans, elevations, sections, details, and attachments to other work:

- (1) Floor Boxes
- (2) Flat Panel Display In-Wall Boxes
- (3) Wall Mount Junction Boxes
- (4) Pull Boxes
- (5) Ceiling Mount Plates
- (6) Projection Screens

G. QUALITY ASSURANCE

1. General:

- a) Floor Boxes provide the interface between power, audio-video (A/V), and communications cabling in concrete floors and decks at activation locations requiring power, audio-video, or communication device outlets.
 - (1) ADA Compliance: Flush-mounted floor device outlets shall not create tripping hazard.
- b) Flat Panel Display In-Wall Storage Boxes provide the interface between power, audio-video (A/V), and communications cabling in recessed cavity of wall behind flat panel displays where power, communication and/or A/V device outlets and/or device storage/mounting is required.
- c) Wall Mount Junction Boxes provide the interface between power, audio-video (A/V) and communications cabling in walls at activation locations requiring power, audio-video, or communication device outlets.
- d) Pull Boxes provide an accessible pathway in a run of conduit to facilitate the pulling in of wires and cables.
- e) Ceiling Mount Plates provide the structural interface to mounting active electronic devices provided and installed by Division 27 AV contractor.

2. Manufacturer Qualifications: Firms regularly engaged in manufacture of floor boxes, poke-thru devices and in-wall storage boxes of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide floor boxes, poke-thru devices, in-wall storage boxes, electrical junction boxes, pull boxes and plenum ceiling boxes that are produced by a manufacturer listed in this section.

3. Electrical Raceways and Components: Comply with requirements of applicable local codes, NEC, UL, and NEMA Standards pertaining to raceways and components. Listed and labeled in accordance with NFPA 70, Article 100.

H. DELIVERY, STORAGE AND HANDLING

- 1. Deliver floor boxes, poke-thru devices, and in-wall storage boxes and associated fittings in factory labeled packages.
- 2. Store and handle in strict compliance with manufacturer's written instructions and

recommendations.

3. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 PRODUCTS

A. GUIDELINES

1. Floor Boxes, Flat Panel Display In-Wall Junction/Storage Boxes, Wall Mount Junction Boxes, Pull Boxes, Ceiling Mount Plates, Projection Screens and associated conduit where specified shall be furnished and installed by the Division 26 Electrical Contractor selected by the Owner unless specifically excluded in these specifications or drawings.
 - a) Coordinate with AV Contractor regarding proper placement of duplex outlets for any AV designated floor box or Poke-thru Device. Electrical circuits should be connected (and outlets wired) to the designated AV circuit breaker panel (N.I.C). Ensure that "Star" ground configuration is properly implemented. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.
2. Floor Box Inserts/Plate and Poke-thru Device Inserts/Plates shall be furnished and installed by the AV Contractor selected by the Owner unless specifically excluded in these specifications or drawings.
3. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

B. ACCEPTABLE MANUFACTURERS

1. Basis of Design Product:
 - a) The design for floor boxes and fittings is based on the Evolution Floor Box Series manufactured by Legrand/Wiremold , 60 Woodlawn Street, West Hartford, CT 06110; toll-free 800-621-0049, telephone 860-233-6251, fax 860-232-2062; Web Site: www.legrand.us/wiremold.com.
 - b) The design for in-wall storage boxes and fittings is based on the PAC52* Series In-Wall Storage Box Series manufactured by Chief Manufacturing, 6436 City West Parkway, Eden Prairie, MN 55344, toll-free 800-582-6480, telephone 952-894-6280, fax 877-894-6918, Web Site: www.chiefmfg.com.
 - c) The design for wall junction boxes and fittings is based on products manufactured by: RACO, 3902 West Sample Street, South Bend IN 46634-4002, telephone 800-722-6437, Web Site: www.hubbell-rtb.com,
 - d) The design for pull boxes and fittings is based on products manufactured by Hoffman, a Pentair Company, 2100 Hoffman Way, Anoka, MN, telephone 763-421-2241, fax 763-422-2600; Web Site: www.hoffmanonline.com.
 - e) The design for ceiling mount plates is based on products manufactured by Chief Manufacturing, 6436 City West Parkway, Eden Prairie, MN 55344; toll-free 800-582-6480, telephone 952-894-6280, fax 877-894-6918, Web

Site: www.chiefmfg.com.

- f) The design for projection screens is based on products manufactured by Draper, Inc., 411 South Pearl Street, Spiceland, IN 47385, toll free 800-238-7999, telephone 765-987-7999, fax 765-987-7142, Web Site: www.draperinc.com.

2. Substitutions will be considered under provisions of Section 01 25 00.

C. FLOOR BOXES

1. Classification and Use: Floor boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and/or UL514C and Canadian Standard C22.2, No. 18.1-04 and 18.2-06 and bear the U.S. and Canadian UL Listing Mark. Floor boxes shall also have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Devices shall be classified for use in 2-hour rated, unprotected reinforced concrete floors and 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the floor boxes). Floor boxes shall also conform to the standards set in Section 300-21 of the National Electrical Code. Floor boxes shall meet UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. Floor boxes shall also have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, bare concrete, terrazzo, wood, and carpet covered floors. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.
2. Floor Boxes, General: Evolution Series Floor Boxes for use on above grade concrete floors, raised floors or wood floors. Provide boxes with a component to permit installation in polished concrete or terrazzo floors. Boxes shall be compatible with complete line of Ortronics® workstation connectivity outlets and modular inserts.
 - a) Floor boxes provide the interface between power, communication and audio/video (A/V) cabling in above-grade floors, on-grade concrete floors, raised floors, wood floors, and fire-classified floors and the workstation or activation location where power and communication and/or A/V device outlets are required. Boxes shall provide recessed device outlets that will not obstruct the floor area. Refer to Drawings for size and types.
 - b) Floor boxes shall permit all wiring to be completed at floor level. The FC models shall be used as defined by the UL Fire Resistance Directory at a minimum spacing of two (2) ft. [610mm] on center.
3. (FB T1) Model EFB6S Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 13-7/8" W x 4-3/16" H [385mm x 351mm x 107mm]. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide

boxes with six (6) independent wiring compartments that allow for up to six (6) receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 32-in³ [524ml]. Each of the two (2) center compartments shall have a minimum wiring capacity of 38.5-in³ [630ml]. Each of the six (6) compartments shall have a minimum depth of 3-7/8" [98mm] behind the plate. Provide boxes with removable compartments to facilitate installation and moves, additions, and changes. The compartments shall be removable from the top and back of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable knockout plates to allow for the maximum cable pass-through area. The cable pass-through area shall be a minimum of 6-15/16 in² [176mm²]. The box shall contain the following number of knockouts: 10 1" trade size, six (6) 1-1/4" trade size, six (6) 3/4" trade size, and two (2) 2" trade size. Boxes shall be able to accept up to (6) six 2" trade size conduit feeds in the sides of the boxes, through the use of the EFB6S-2HUB and maintain a 4-inch deep concrete pour. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors. The box shall be able to accept 2-3/4" x 4-1/2" standard size wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn lock, 30 amp straight blade and 30 amp turn lock receptacles, Ortronics® workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

4. (FB T2) Model EFB8S Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 12-3/4" W x 6-1/16" H [385mm x 324mm x 154mm]. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with eight (8) independent wiring compartments that allow for up to eight (8) receptacles, communication and/or audio/video services. Boxes shall accept standard size single gang (2-3/4" x 4-1/2"), double gang (4-9/16" x 4-1/2"), and triple gang (6-3/8" x 4-1/2") wall plates. Boxes shall permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 28-in³ [455ml]. Each of the four (4) center compartments shall have a minimum wiring capacity of 34-in³ [524ml]. Each of the eight (8) compartments shall have a minimum depth of 3-1/2" [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation and moves, additions, and changes. The compartments shall be removable from the top and back of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable knockout plates to allow for the maximum cable pass-through area. The cable pass-through area shall be a minimum of 11-5/8 in² [7500mm²]. The box shall contain the following number of knockouts: four (4) 3/4-inch trade size, eight (8) 1-inch trade size, six (6) 1-1/4-inch trade size, and two (2) 2-inch trade size. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete

pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn lock, 30 amp straight blade and 30 amp turn lock receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate Ortronics® workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

D. FLAT PANEL DISPLAY IN-WALL JUNCTION/STORAGE BOX

1. Classification and Use: In-Wall Storage Boxes shall have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. UL Classification Mark. In-wall storage boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.
2. (FPD T1) Model PAC525FCW In-Wall Storage Box with Flange and Cover: Manufactured from stamped steel approved for use in standard 3.5" stud and 2.5" stud walls with the same product. Box shall have a finished interior, black in color. Boxes shall be 9" H x 14.25" W x 3.9" D [228.6mm x 361.95mm x 99.06mm]. Knockouts shall be provided for single gang outlets and 1-1/4" & 1/2" conduit. Box shall have universal zip tie anchor points. Box shall be provided with a paintable flange and cover. Cover shall include tamper proof security and include four knockouts for cable routing and ventilation.
 - a) Provide with Raco 560 3" x 2" box, 2-3/4" deep electrical box.
 - b) Provide with Raco 864 single duplex electrical box cover.
3. (FPD T2) Model PAC526FCW Large In-Wall Storage Box with Flange and Cover: Manufactured from stamped steel approved for use in standard 3.5" stud and 2.5" stud walls with the same product. Box shall have a finished interior, black in color. Boxes shall be 14.25" H x 14.25" W x 3.9" D [361.95mm x 361.95mm x 99.06mm]. Knockouts shall be provided for single gang outlets and 1-1/4" & 1/2" conduit. Box shall have universal zip tie anchor points. Box shall be provided with a paintable flange and cover. Cover shall include tamper proof security and include four knockouts for cable routing and ventilation.
 - a) Provide with Raco 560 3" x 2" box, 2-3/4" deep electrical box.
 - b) Provide with Raco 864 single duplex electrical box cover.

E. JUNCTION BOXES

1. All device boxes for communications systems shall be extra-deep designation.
2. Sheet Metal Junction Boxes: NEMA OS 1, UL 514A, galvanized steel with stamped knockouts.
3. Wall mounted communication boxes concealed within the wall shall be a minimum 4-11/16" square with a minimum depth of 3" with reducer device plate per schedule.
4. Antenna Junction Box (A) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with

Raco 843 single gang device cover.

5. AV Plate Junction Box (AVP 1G) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 843 single gang device cover.
6. AV Plate Junction Box (AVP 2G) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 818 two gang device cover.
7. AV Plate Junction Box (AVP 3G) Raco Model 263 Electrical Junction Boxes shall be 3-1/2" Deep, 6" Square with (6) 1/2"-3/4", (2) 3/4"-1" and (2) 1"-1-1/4" side knockouts and (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" bottom knockouts. Box shall be provided with Raco 793 three gang device cover.
8. Camera Junction Box (CAM) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 818 two gang device cover.
9. Intercom Call Button (CB) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 843 single gang device cover.
10. Listening Assist Transmitter Junction Box (LA) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 818 two gang device cover.
11. Projector (PRJ) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 818 two gang device cover.
12. Wall Mount Paging Speaker (PS) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 843 single gang device cover.
13. Wall Mount Sound Reinforcement Speaker Junction Box (S) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 843 single gang device cover.
14. Switch Junction Box (SWT) Raco Model 471 Electrical Junction Boxes shall be 2-1/4" deep, 3" x 2" with one 1/2" conduit knockout.
15. Volume Control Junction Box (VC) Raco Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Raco 843 single gang device cover.
16. Wall Control Panel Junction Box (WCP 1G) Raco Model 260 Electrical Junction

Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Racor 843 single gang device cover.

17. Wall Control Panel Junction Box (WCP 2G) Racor Model 260 Electrical Junction Boxes shall be 3-1/4" deep, 4-11/16" square with (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" side knockouts and (2) 1/2" & (2) 3/4"-1" bottom knockouts. Box shall be provided with Racor 818 two gang device cover.
18. Wall Control Panel Junction Box (WCP 3G) Racor Model 263 Electrical Junction Boxes shall be 3-1/2" Deep, 6" Square with (6) 1/2"-3/4", (2) 3/4"-1" and (2) 1"-1-1/4" side knockouts and (2) 1/2"-3/4", (2) 3/4"-1" and (2) 1-1/4" bottom knockouts. Box shall be provided with Racor 793 three gang device cover.
19. Specific-use Wall Junction Boxes:
 - a) For situations where oversized conduit is used so a standard 4-11/16"x4-11/16" box is inadequate for the terminations required, use:
 - (1) Hubbell Recessed Wall Mounted Gang – WSCS-MMO-X per schedule, or approved equal.

F. PULL BOXES

1. Small Sheet Metal Pull Boxes: NEMA OS1; galvanized steel
2. Minimum size:
 - a) 4" square by 2.125" deep for use with 1" conduit and smaller
 - b) 4-11/16" square by 3" deep for use with 1-1/4" conduit and larger.
3. Maximum size:
 - a) 24" square by 8" deep for collecting multiple 1" station conduit. Sheet metal boxes larger than 12" in any direction are required to have a hinged cover or a chain installed between box and cover.
4. Manufacturers: Hoffman Enclosures or approved equal. Field fabricated boxes are not allowed.
5. Floor Mounted Rack Pull Box (FRK) Hoffman Item #ASE16X14X4NK 16" x 14" x 4" deep square pull box. Box shall be provided with screw cover.
6. Millwork Mounted Rack Pull Box (MRK) HOFFMAN ASE8x9x3 8" x 9" x 3" NEMA 1 pull box. Box shall be provided with screw cover.
7. Wall Mounted Rack Pull Box (WRK) Hoffman Model ASE16X14X3 16" x 14" x 3" screw cover pull box at wall behind rack.
8. Ceiling Mount Paging Speaker Pull Box (PS) – Hoffman Model ASE4X4X3 4" x 4" x 3".
9. Ceiling Mount Sound Reinforcement Loudspeaker (S) – Hoffman Model ASE4X4X3 4" x 4" x 3"

G. MOTORIZED, CEILING RECESSED, FRONT PROJECTION SCREENS

1. Remove existing owner provided projection screens and re-install where indicated

PART 3 EXECUTION

A. EXAMINATION

1. Examine conditions under which boxes, poke-thrus' fittings, and projection screens are to be installed and substrate that will support boxes. Notify the Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.
 - a) Do not begin installation until substrates have been properly prepared.
 - b) Verify rough-in openings are properly prepared.

B. DOCUMENT INTERPRETATION

1. The locations of the outlet symbols shown in the Drawings represent a close approximation of the exact location where the outlet shall be installed. This location may be shifted left or right eight inches to allow for stud alignment or coordination with electrical outlet locations. Approval by Owner is required for more extensive adjustments to outlet location.
2. Outlet Schedule
 - a) Refer to the outlet schedule contained [on the Drawings sheet XXX] for outlet mounting height, device box size, and station conduit size.

C. PREPARATION

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

D. INSTALLATION

1. Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.
2. Mechanical Security: Raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, device mounting brackets, and cabinets, in accordance with manufacturer's installation sheets.
3. Accessories: Provide accessories as required for a complete installation, including insulated bushings and inserts where required by manufacturer.
4. Unused Openings: Close unused box openings using manufacturers recommended accessories.
5. Outlet Box Mounting:
 - a) Station cable boxes shall be 4-11/16" square x 3" deep regardless of cable count or cable type.

- b) Height: unless otherwise noted in the Outlet Schedule, all communication outlet boxes shall be installed at the same height as electrical outlets, except WCP outlets, which shall be installed at 48 inches AFF to center of box.
- c) Install boxes to accommodate device indicated by symbol, in conformance with code requirements and consistent with type of construction.
- d) Install the appropriate work cover on all outlet boxes.
- e) Set front edge of device box flush with the finished surfaces except on walls of noncombustible materials where the boxes may have maximum set back of ¼". Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- f) Set outlet boxes parallel to construction and independently attached to same.
- g) Do not install back-to-back and through-the-wall boxes. Install with a minimum 6" horizontal separation between closest edges of the boxes. Install with minimum 24" separation in acoustic rated walls.
- h) Outlet boxes for audiovisual shall be in a separate box from electrical outlets.

6. Box Support:

- a) Mount boxes straight and plumb.
- b) Install stud support one side, with short piece of stud, for up to 2-Gang device boxes.
- c) Do not support boxes with tie-wire.
- d) For one- and two-gang box support, manufactured bracket supports shall be accepted alternate.
- e) Support boxes independently of raceways.
- f) Install adjustable steel channel fasteners for hung ceiling outlet boxes.
- g) Install stamped steel bridges to fasten flush-mounted junction box between studs.
- h) Do not install boxes to ceiling support wires or other piping systems.
- i) When boxes are installed in fire-resistive walls and partitions, provide 24" horizontal separation between boxes on opposite sides of a wall. In addition, limit penetrations to 16 square inches per penetration and not to exceed a total of 100 square inches per 100 square feet of wall area. Apply fire stop putty or muffins acceptable to the authority having jurisdiction (AHJ).

7. Projection Screen Installation

- a) Install in accordance with manufacturer's instructions.

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- b) Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.
- c) Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

E. CLEANING AND PROTECTION

- 1. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- 2. Protect boxes and fittings until acceptance.

F. STORAGE AND HANDLING

- 1. Schedule delivery to minimize delays in the project.
- 2. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

END OF SECTION

SECTION 27 41 16 - INTEGRATED AUDIO VISUAL SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This document covers the general requirements for the installation of Audio Visual (AV) systems for the University of Texas Health Science Center at Houston School of Nursing Level 4 Simulation Lab Project. This project is a remodel/renovation project and encompasses the AV specifications, technical standards and installation procedures associated with the total or partial development of the AV component within the project as it pertains to:
1. Lobby digital signage systems.
 2. Skills & Tasks classroom AV presentation systems.
 3. Debrief rooms AV presentation systems.
 4. Patient Flex and Home Health rooms medical simulation AV system components.
 5. Control Room medical simulation AV system components.
 6. Exam rooms medical simulation AV system components

1.2 THE SPECIFICATION

- A. The "Specification" is defined as the body of documentation provided to the Bidder with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as "herein" refer to the entire Specification, and not just this written document.
- B. The Specification includes, but is not limited to:
1. This written specification document.
 2. All drawings, as listed in the List of Drawings.
 3. Additions and/or modifications as detailed in written Addenda.
 4. Additions and/or modifications as detailed in drawing additions or reissues.
- C. The purpose of the Specification is to provide sufficient detail for the Bidder to understand the functional requirements of the systems, the installation and performance standards that must be met, and the required Scope of Work, in order to generate and submit a complete and accurate bid.

1.3 INTENT OF THE SPECIFICATIONS

- A. It is the intent of these Specifications to describe and provide for Audio-Visual

systems of high professional quality and reliability. Consequently, rigid performance standards by the Audio-Visual System Contractor and the equipment will be required. In all cases, the Architect shall determine the acceptability of the work based upon the observations, visits and reports of the Consultant.

- B. Prior to the consideration or approval of proposed substitutions, manufacturer product samples may be required for testing.
- C. Notwithstanding anything to the contrary, complete systems will be furnished and installed including all necessary options, licenses and accessories.
- D. Where discrepancies appear, the greater quantity and better quality will be furnished.

1.4 DEFINITION OF TERMS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
 - 1. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract, without any implied meaning extending the Architect's responsibility into the Contractor's area of Contractor coordination, supervision, or means and methods of construction as outlined in the Conditions of the Contract.
 - 2. "As Indicated": Means indicated in the Contract Documents. Other terms, including "shown", "noted", "scheduled", and similar terms have the same meaning as "indicated".
 - 3. "Authorities Having Jurisdiction" (AHJ): Means the agencies, either individually or collectively, charged by statute with administration and enforcement of the requirements of building codes and other regulations at the Project location.
 - 4. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.
 - 5. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.
 - 6. "Project Manual": A volume or volumes assembled for the Work which may include the procurement requirements, contracting requirements, and Specifications.
 - 7. "Project Site": Space available for performing construction activities,

either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

8. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

B. Within this section of the specification, the following definitions shall apply:

1. The term "Owner" is used to indicate The University of Texas Health Science Center at Houston School of Nursing.
2. The term "Architect" is used to indicate FKP Cannon Design.
3. The term "Consultant" is used to indicate Datacom Design Group, LLC.
4. The term "Bidder" is used to indicate that entity generating the bid response.
5. The term "Contractor" is used to indicate the successful Bidder to whom the Owner has awarded the Contract.
6. The term "Installer" means the Contractor or other entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor to perform a particular construction operation at the Project site, including preparation, erection, installation, application, construction, re-installation, and similar operations required for execution of the Work.
 - a. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
7. The term "Furnish" is used to indicate the responsibility to procure and ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.
8. The term "Install or "Installation" is used to indicate the responsibility of receiving the item at the job site, assuring adequate storage, unpacking or uncrating the item, physically securing the item or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
9. The term "Provide" is used to indicate the responsibility to both "Furnish" and "Install".

10. The term "Provided by Others" shall refer to material and work which is related to this contract, but has been provided by parties other than the AV Contractor. An example might be in reference to a projection screen installed during building construction but requiring interface to the AV control system.
11. The terms "NIC and Not in Contract" are equivalent to "Provided by Others".
12. The term "OFCl" (Owner Furnished Contractor Installed) shall refer to equipment that will be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
13. The term "Installation Materials" shall reference installed cable, loose cable, terminations, signal extenders, cable management, voice/data/video patch cords, adapters, I/O panels, cable dressing, lacing bars, copper bus bars, labels, rack shelves, rack mounts, power strips/distribution and other materials as needed to install the systems defined herein.
14. The term "Substantial Completion" is used to indicate the stage in the progress of the work where the systems are determined to be sufficiently complete in accordance with the Specification so that the Owner can utilize the systems for their intended use.
15. The term "Final Acceptance" is used to indicate the point in which all contract requirements have been met by the Contractor after Substantial Completion has been achieved. This includes, but is not limited to, the correction and acceptance of any remaining punch list items, approval and delivery of all Final Documents, and user training as specified.
16. The term "shall" is mandatory, the term "will" is informative, and the term "should" is advisory.

1.5 EXCEPTIONS

- A. The Bidder shall notify the Consultant prior to bid submission of any and all exceptions to these specifications and related drawings. This shall include any errors or omissions in the system design and/or any inconsistencies or ambiguities between package documents that, in the Bidder's opinion, may impact costs to the Owner or prevent the systems from achieving all purposes of the Specification.

1.6 ADDENDA

- A. Written or graphic instruments issued by the Architect and/or Consultant prior to execution of Contract, which modify or interpret Bidding Documents by additions, deletions, clarifications or corrections. Addenda shall be binding and become part of the Contract Documents.

- B. Prior to receipt of Bids, Addenda will be issued to all recorded by Architect and/or Consultant as having received a complete set of Bidding Documents.
- C. Bidder is responsible to verify with Architect and/or Consultant that Bidder has received all Addenda. Failure to receive such Addenda shall not relieve Bidder from any obligation under this Bid as submitted.
- D. Addenda issued after receipt of Bids will be delivered to the selected Bidder.

1.7 CODES AND REGULATIONS

- A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.
- B. Execute work in accordance with AV system installation best practices as defined by Infocomm International and The Association for Quality in Audio Visual Technology, Inc., National Electrical Code, and applicable state and local codes.

1.8 REFERENCES AND STANDARDS

- A. Infocomm International, 2003, "Basics of Audio and Visual Systems Design"
- B. Infocomm International, 2008, "AV Installation Handbook – The Best Practices for Quality Audiovisual Systems"
- C. Davis and Davis, 1987, "Sound System Engineering"
- D. Giddings, 1990, "Audio Systems Design and Installation"
- E. IEC 61947-1 ED. 1.0 EN.2002 "Electronic Projection – Measurement and Documentation of Key Performance Criteria – Part 1: Fixed Resolution Projectors"
- F. IEC 61947-2 ED. 1.0 EN.2001 "Electronic Projection – Measurement and Documentation of Key Performance Criteria – Part 2: Variable Resolution Projectors"
- G. Maltese, 2006, "AV9000: Defining Quality in Engineered Audio Visual Systems"
- H. AQAV, 2014, "AQAV Standard AV-9000-2014 Quality Management System for the Audio Visual Technology Industry" Revision 7/1/14"
- I. ANSI/INFOCOMM 3M-2011, "Projected Image System Contrast Ratio"
- J. ANSI/INFOCOMM 2M-2010, "Standard Guide for Audiovisual Systems Design and Coordination Processes"
- K. AVIXA V202.01:2016, "Display Image Size for 2D Content in Audiovisual Systems"

- L. AVIXA A102.01:2017, "Audio Coverage Uniformity in Listener Areas"
- M. AVIXA RP-C303.01:2018, "Recommended Practices for Security in Networked AV Systems"
- N. AVIXA F501.01:2015, "Cable Labeling for Audiovisual Systems"
- O. ANSI/INFOCOMM 4:2012, "Audiovisual Systems Energy Management"
- P. INFOCOMM 10:2016 DS1, "Audiovisual Systems Performance Verification"

1.9 RELATED DOCUMENTS

- A. The General Conditions, Requirements, and Special Provisions of any larger body of specifications of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Bidder shall immediately notify the Architect and/or Consultant for clarification and direction.
- B. Section 26 00 00 – Electrical
 - 1. Including all Sub-Sections
- C. Section 27 00 00 – Communications
 - 1. Including all Sub-Sections
- D. Section 28 00 00 – Electronic Safety and Security
 - 1. Including all Sub-Sections

1.10 SCOPE OF THE WORK

- A. The Contractor shall provide complete, turnkey audiovisual (AV) systems performing all of the services and functions described herein, together with all other apparatus, cable, materials, labor, tools, transportation, and any other resources necessary to provide a complete system conforming to the design intent for the University of Texas Health Science Center at Houston School of Nursing Level 4 Simulation Lab Project.
- B. Specifically, the work shall include, but is not limited to:
 - 1. Coordination
 - a. Communicating and coordinating directly with the Consultant, Owner, Architect and other trades, complying with all requirements as defined under this Scope of Work and elsewhere, to fulfill all requirements of the Specification.
 - b. Scheduling installation operations in sequence required in order to obtain best completion results.

- c. Coordinating installation of different components to assure maximum accessibility for required maintenance, service and repair.
- d. Verifying required cable lengths for all bulk cable or manufactured cable assemblies prior to ordering as outlined in 'Installation Practices'.
- e. Verify the accuracy of Master Quote or other quotation numbers prior to ordering. Where given, Master Quote numbers or other quotation numbers have been provided for bidding purposes only.

2. Documentation

- a. Generating and submitting Shop Drawings as required for approvals and As-Built drawings as specified herein.
 - 1) Note - The Architect or Consultant is under no obligation to provide Contractor with digital drawing files. However, digital drawing files may be provided to the Contractor at no cost for use in the development of Shop Drawings or As-Built drawings under separate agreement between Contractor and Architect and/or Consultant.
- b. Generating and Submitting "Progress Reports" as defined herein.
- c. Documenting the completed installed systems as defined herein.

3. Design Verification and Acceptance

- a. Verifying the accuracy of the system designs documented in the Specifications and acceptance of responsibility. Any issues, discrepancies, substitutions, or exceptions to the Specification by the Contractor shall be communicated to the Consultant prior to the purchase of any equipment or materials by way of the Shop Drawings Submittal process. Upon approval of the Contractor's Shop Drawing Submittal by the Owner's designated representative, or if the Contractor fails to submit Shop Drawings, the Contractor shall assume all responsibility for supplying such materials and taking such actions as to satisfy the full intentions of the Specification without claim for any additional compensation. This shall include providing any incidental equipment, accessories, licenses, installation materials and labor needed in order to result in a complete and operable system, even if such equipment, materials or labor are not listed in this Specification. Exceptions include Owner-requested changes, unexpected field issues due to work by other trades, or schedule changes initiated by others.

4. Cabling, Equipment and Installation

- a. Providing all cable and pull strings in conduits for the specified systems, except where otherwise noted.
- b. Providing station cables for connection of IP-enabled audiovisual equipment to associated data network outlets, including but not limited to instructor's computers, production computer's, laptop connections, control system processors, codecs, displays and projectors. This applies to all equipment installed by the Contractor, including Owner Furnished (OFCL) items. Coordinate station cable requirements with the greater building-wide structured cabling system.
- c. Providing portable interconnection cables for connection of ancillary devices to the audiovisual system where ancillary device connection has been directly designed or can be reasonably assumed.
- d. Coordinating and providing cable labels as stipulated by the Owner and/or specified herein.
- e. Furnishing and/or installing all equipment as specified.
- f. Installing Owner furnished equipment as specified.
- g. Providing loudspeakers as complete assemblies with back boxes, grilles, tile bridges, wall mounts, hanging hardware and other installation hardware as required.
- h. Coordinating with the Architect and Owner on final color selection, and/or the painting of any exposed loudspeakers and any/all exposed system components to match the room's aesthetics and finishes.
- i. Coordinating with local entities and necessary (manufacturer, Owner, SBE, FCC, etc.) to determine final channel selection for all wireless devices and resolve conflicts where they may occur.
- j. Providing to the Owner, upon completion, all accessories and ancillary items included with the manufacturer's equipment but not used for the physical installation of the device. This shall include all user manuals, remote controls, batteries, tools, installation hardware, carrying cases, protective covers, etc.
- k. Furnishing all lifts, ladders, scaffolding or other resources as needed for proper and safe installation. Coordinate with other trades as needed.
- l. Interconnecting all components, both internal and external to

rack cabinets.

- m. Ensuring that all cabling, equipment, and terminations are installed in accordance with accepted industry standards, approved Shop Drawings, manufacturer's recommendations and as stipulated herein.
- n. Providing cable management hardware as required including that required internal to rack cabinets, that required between pieces of equipment not housed in rack cabinets, and that required to extend cabling from rack cabinets and equipment to the greater facility cabling infrastructure.
- o. Providing custom cover plates, wall plates, I/O connection plates, floor box insert plates as required. Coordinate with Architect and/or Owner on the final selection of finishes.
- p. Insuring that all equipment, with the exception of portable equipment, is firmly fastened or attached in place. A safety factor of at least five shall be utilized for all brackets, fasteners, and attachments. Provide safety retention cables for overhead equipment such as loudspeakers, projectors, etc.
- q. Insuring that all equipment mounting styles and locations comply with the 2010 ADA Standards for Accessible Design.
- r. Providing any/all patching, caulking, fire stopping, and painting required to restore damaged finished during installation.

5. Furniture

- a. Providing audiovisual lecterns, credenzas, tables and other technical furniture where specified.
- b. Coordinating with the Consultant, Architect and Owner on the final selection of all technical furniture including design details (make/model), available options, dimensions, cable management and ventilation needs, color and finish.
- c. Coordinating with furniture manufacturer or others who are providing all necessary furniture/millwork modifications ("cut-outs" or other) as required allowing for a neat and professional installation of integrated technology system components. This includes, but is not limited to: integrated table/lectern "cubbies", table-top microphones, cable management grommets, etc., and providing manufacturer' cut-out templates to others when requested.
- d. Coordinating with the furniture manufacturer, Owner and Architect on cable management needs and equipment installation requirements, including AC power distribution

required in all furnishings so equipped and as outlined in "Installation Practices".

6. Coordination with Owner's Network
 - a. Securing from Owner private IP addresses for use by Ethernet equipped audiovisual devices. No Ethernet equipped device shall be connected to Owner's network without the express permission of the Owner. This shall include, but is not limited to, configuration parameters such as DHCP, IP addresses, subnet information, VLAN setup and authorization.
 - b. Confirming with the Consultant that coordination with the Owner regarding Ethernet equipped audiovisual devices as outlined in "Submittals – Software".
7. Control System Programming
 - a. Providing Control System design submittals and two Control System design revisions as outlined in "Submittals – Software".
 - b. Developing and installing all custom control programming code as required and/or as specified herein.
 - c. Providing centralized media control systems including GUI (Graphical User Interface) and code development in order to satisfy the guidelines outlined herein.
 - d. Developing Control System help-desk and system administrator functionality as defined herein.
 - e. Providing Control System interfaces to mechanical systems including motorized screens, as specified.
 - f. Providing low voltage control system control of facility lighting where specified.
 - g. Providing the executable (uncompiled) programming control code as defined herein.
 - h. Developing and installing all custom software for Digital Signal Processor (DSP) devices as required to optimize system performance.
8. Testing, Training, Acceptance and Warranty
 - a. Ensuring that all individual components function as intended by this Specification.
 - b. Ensuring that the entire audiovisual systems function as intended by this Specification.

- c. Testing, adjusting, and fine-tuning the completed systems and components.
 - d. Coordinating and participating in a Systems Performance Verification review with the Owner and Consultant.
 - e. Providing “sign-off” documents for each space type as defined herein.
 - f. Conducting training in systems operation and maintenance for the Owner’s designated representative(s).
 - g. Providing a Warranty Service Contract as defined herein.
- C. Work Excluded: Work not included under the contract shall be:
- 1. Providing conduit, power receptacles, junction boxes, cable raceways, electrical back-boxes, and floor boxes, except as specifically called out herein.
 - 2. Providing lighting fixtures, lighting dimming systems, lighting controllers, and lighting system low voltage AV interfaces at the dimmer side, except as specifically called out herein.
 - 3. Providing blocking as required to support wall-mounted audiovisual components.
 - 4. Providing window treatments and motorized shade system low voltage AV interfaces at the controller side.
 - 5. Providing telecommunications structured cabling systems, including horizontal and backbone cabling and termination, voice and data face plates, associated racks and cabinets, raceway and cable management.

1.11 PROJECT/SITE CONDITIONS

- A. Conflicts: The Bidder shall be responsible for investigating any potential conflicts with site-related issues regarding use of personnel, scheduling, access to the site, storage of tools and equipment on-site, and other areas of potential conflict. If these issues impact the Bidder’s Bid Response, the impacts on cost and schedule should be clearly noted in the Bid Response.
- B. Coordination: In the interest of a coordinated and professional project, the Contractor shall:
 - 1. Coordinate his/her work with that of other trades. The Contractor should anticipate attending project coordination meetings with the Owner, Architect, General Contractor, Consultant or other trades as required.
 - 2. Afford other trades reasonable opportunity for installation work and for

storage of materials.

3. Staff the job to keep pace with other Trades.
- C. Equipment Delivery and Storage Costs: Costs of all shipping to the site, and of all unusual storage requirements, shall be borne by the Contractor. It shall be the responsibility of the Contractor to make appropriate arrangements, and to coordinate with the authorized personnel at the site for the proper acceptance, handling, protections, and storage of equipment so delivered.
- D. Refuse / Cleaning Up:
1. The Contractor shall keep the site and building free of all debris and clutter, to the satisfaction of the Owner or site manager. On a daily basis, the Contractor shall remove refuse and rubbish related to the specified work from the site and shall leave the relevant areas and equipment clean and in an operational state. The Contractor shall be responsible for repairing any damage caused to the premises by the Contractor's installation activities at no cost to the Owner.
 2. At completion of the Work, the Contractor shall remove from and about the project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.
 3. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.
- E. Use of Site:
1. Contractor shall adhere to the Owner's instructions regarding non-smoking, noise, signs, advertisements and fires.
 2. The Contractor shall confine operations at the site to areas permitted by the Contract Documents and shall not unreasonably encumber the site with materials or equipment.
 3. Cutting and Patching:
 - a. The Contractor shall be responsible for cutting, fitting or patching as required to complete the Work or to make its parts fit together properly.
 - b. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate

contractor the Contractor's consent to cutting or otherwise altering the Work.

4. Access to Work: The Contractor shall provide the Owner, Architect and Consultant access to the Work in preparation and progress wherever located.

1.12 JOB CONDITIONS

A. Space Conditions

1. Architectural reference drawings provided to the Contractor for bidding purposes may not reflect construction site as-built conditions. It shall be the responsibility of the Contractor to field-verify all site conditions relevant to his work.
2. The Contractor shall verify dimensions of equipment, equipment arrangements, space availability (including any millwork or cabinetry provided by others) and provide systems that work within constraints of the space available. The Contractor shall notify the Consultant of any situation where space constraints are a problem, prior to the submission of shop drawings or the ordering or purchase of equipment. The Contractor shall bear the expense of providing alternate equipment which will work within the available space, if space availability problems are discovered after shop drawings are submitted and approved.
3. Drawings indicate locations of equipment and components. Changes in the location and offsets of same to accommodate building conditions, and coordination with the work of other trades shall be made prior to installation, without additional cost to the Owner.
4. The Contractor shall insure during installation that access is provided to equipment and components requiring operation, service or maintenance within the life of the system.
5. It shall be the responsibility of the Contractor to identify any condition where the recommended environmental and/or electrical operating parameters for specified equipment/products cannot be assured. Should such condition exist, it shall further be the responsibility of the Contractor to notify the Architect and Consultant of any such condition.

1.13 SUBMITTALS

A. General

1. Refer to Division 1
2. Submit in quantities, format and timetable as required by General Conditions.

B. Product Data Manuals

1. Minimum number of sets:
 - a. Four (4).
 2. Timetable:
 - a. Submit within twenty-one (21) calendar days after award of contract.
 - b. Submit simultaneously with Shop Drawings.
 - c. Allow minimum of fourteen (14) calendar days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
 - d. Review and approval of Product Data is required before equipment purchase and installation.
 - e. Submit product data sheets together electronically as one bound PDF format document.
- C. Shop Drawings
1. Minimum number of sets:
 - a. Four (4)
 2. Timetable:
 - a. Submit within twenty-one (21) calendar after award of contract.
 - b. Submit simultaneously with Product Data Binders.
 - c. Allow minimum of fourteen (14) calendar days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
 3. Description:
 - a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
 - b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
 - c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.

- d. Number and title each drawing in logical manner as a set.
- e. Include cover sheet with listing of all drawings included in bound set.
- f. Ensure that labeling on Shop Drawings match labeling on equipment.
- g. Minimum Scale:
 - 1) Floor Plans: 1/8 inch = 1 foot
 - 2) Rack Elevations: 1-1/2 inch = 1 foot
 - 3) Plate/Panel Details: 6-0 inches = 1 foot
 - 4) Loudspeaker Details: 1-0 inch = 1 foot
- h. Include as a minimum:
 - 1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
 - 2) Schematic diagrams showing all primary and secondary devices, interconnectivity and signal flow.
 - 3) Plate details showing size, material, finish, connectors, engraving, etc.
 - 4) Mounting detail drawings of loudspeakers, racks, and overhead equipment.
- i. If required by the General Conditions, the Architect, or the AHJ, provide services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal.
- j. Equipment rack elevations
- k. Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
- l. Electrical power wiring diagram. Include circuit, switching, and control details.
 - 1) Wiring diagram of grounding and shielding scheme.
 - 2) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
 - 3) General construction drawings necessary for completion of work.

- D. Operation and Maintenance Manuals
1. Minimum number of sets:
 - a. One (1) hard copy and three (3) electronic as a single bound PDF document.
 2. Format and Minimum Information:
 - a. Section 1 – System Operation
 - 1) Introduction/Overview to system components and their functions and locations. Include a brief listing of basic system functions.
 - 2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
 - 3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.
 - b. Section 2 – System Documentation
 - 1) Simplified system one-line schematic diagram showing changes made during construction.
 - 2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
 - 3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
 - 4) All Shop Drawings corrected to reflect as-built conditions.
 - 5) Other data and drawings required during construction.
 - 6) Initial Tests and Adjustments data.
 - 7) Final Tests and Adjustments data.
 - 8) Electronic copies of all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
 - c. Section 3 – Manufacturer's Documentation
 - 1) Provide for each equipment model, at no additional costs to Owner even if manufacturer does not include costs of such documentation with purchase of equipment item, the following:
 - a) Manufacturer's Product Datasheet
 - b) Operating Instructions
 - c) Installation Instructions
 - d) Service Information
 - e) Schematic Diagrams
 - f) Replacement Parts List

- d. Section 4 – Maintenance Information
 - 1) Preventative maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
 - 2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
 - 3) Troubleshooting information complete with instructions for procedures during equipment failure.
 - e. Section 5 – Warranty Information
 - 1) System warranty letter
3. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Consultant and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.
4. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

1.14 SUBSTITUTIONS

- A. Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or approved equal". Where this is the case, no substitutions will be accepted without the written consent of the Consultant. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- B. Requests for proposed substitution shall be made in writing to the Consultant.
 - 1. Request shall be received by the Consultant no later than four (4) business days before the bid due date.
 - 2. Request shall include name of material, product or equipment to be substituted and a complete description of proposed substitution including drawings, performance and test data and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.
 - 3. Bidder should be prepared to submit samples if deemed necessary for evaluation and possible destructive testing.

4. Bidder shall assume and bear all responsibility for coordinating and performing related changes in the Work necessitated by such substitution and has included such costs in the Bid.
- C. All approved substitutions shall be communicated via Addenda. No Bidder shall rely upon approvals made in any other manner.
- D. No substitutions will be considered after award of Contract, unless otherwise approved by Owner.

1.15 COOPERATION AND COORDINATION

- A. The Audio-Visual System Contractor shall cooperate and coordinate as required with other Divisions, Trades, Contractors, and Subcontractors who are responsible for work not included in this Section. He shall provide, in a timely manner, any and all information as required or requested in order for this work to be completed to the satisfaction of the Architect and in the best interests of the Project. Requested assistance or information shall be transmitted in writing to the requesting party in all cases.

1.16 WORK BY OTHER DIVISIONS

- A. All conduit, floor boxes, poke-thru devices, in-wall storage boxes, electrical junction boxes, pull boxes and plenum in-ceiling storage boxes as shown on the Drawings are furnished and installed by Division 26 except where otherwise indicated. Audio-Visual System conduit, utility boxes and speaker enclosures are shown on the Audio-Visual Drawings for reference only and must be verified with the Electrical Contractor. Conduit to the equipment racks shall be run to the racks and connected with insulated sleeves so that no metal conduit ties directly to the racks.
- B. 120V, 60 Hz AC power to the equipment racks and other AV related equipment and connection of that power is by Division 26. AC wiring and distribution within equipment racks is by this section.
- C. All cables penetrating walls must be run through approved sleeves. Where cables penetrate fire-rated walls, approved sleeves with Firestop to be used.

1.17 QUALITY ASSURANCE

- A. AV Contractor Qualifications
 1. The Audio-Visual System Contractor shall normally be engaged in the business of furnishing and installing professional commercial AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of an approved AV Contractor as subcontractor to perform work described herein.
 2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit

complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.

3. The AV contractor must provide proof of being an Authorized Dealer for all major lines of equipment listed in Part 2. Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered. This training must have been completed within the last two years from the date of the bid.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Project Engineering, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years' experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required. They must also possess an INFOCOMM CTS certification at a minimum.
5. Project Manager assigned to this project must have a minimum of five (5) years' experience in installing and integrating AV systems of similar scale. Project Manager shall also have either Infocomm CTS-I or CTS-D or Project Management Institute PMP certification.
6. Control system personnel interfacing with control system programming assigned to the project must be certified by the control system manufacturer to program their designated system type with a minimum of five (5) years' experience. A copy of the certification must be provided.
7. Installed systems shall comply in product, performance, and practices as outlined in the document "AV 9000" given in the References and Standards as listed in Section 1.9. The Contractor shall certify compliance by furnishing affidavits prepared by individuals on behalf of the vendor with recognized industry qualifications, namely CTS-D and/or CTS-I (Certified Technology Specialist – Design, Installation), or CQD and/or CQT (AV9000 Certified QA Designer, Technician). Affidavits shall reflect that the system passed a Design Review, Staging, and the Commissioning battery of tests without defect before the system can be accepted.
8. Prospective bidders must attest that they possess, and are skilled in the use of, all the necessary test equipment for verifying that the performance of the system is in compliance with AV9000. The Bid Response must include the name of the certified qualified individual(s) assigned to the project, so that credentials may be verified on the Infocomm International Association's website, or with the Association for Quality in Audio Visual Technology, Inc. (AQAV).

9. No final payment will be made until these certificates have been presented by the Contractor for review by the Owner or his representative. The Owner retains the right to enlist the services of a third party Testing and Verification Services Provider to verify compliance, and may elect to do so in the event of any discrepancy in test results. Vendor's final payment may be offset by the cost of corrective actions as well as third party re-testing.
- B. Unless otherwise stated, all equipment for this installation will be new, less than one year from the date of manufacture, and without blemish or defect.
1. All electrical, electronic and optical equipment provided by the contractor shall be a product of companies regularly engaged in the manufacture of electrical, electronic or optical equipment.
 2. The equipment shall be the latest model or type offered which meets the applicable specifications at the time of submittal. Discontinued items replaced by newer models or versions are prohibited from use in the project. It shall be the Contractor's responsibility to provide the Consultant with information regarding discontinued products listed in the specification. If a product listed is discontinued prior to installation, the Contractor shall submit a substitution request.
 - a. Request shall include name of material, product or equipment to be substituted and a complete description of proposed substitution including drawings, performance and test data, and other information necessary to demonstrate that the substitution will meet all intentions of this Specification or required for a complete evaluation.
 - b. Contractor shall assume and bear all responsibility for coordinating and performing related changes in the Work necessitated by such substitution. This includes, but is not limited to, changes to other related audiovisual components, installation materials, architectural integration details, software programming, and required infrastructure.
- C. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and shall be verified by observation. Only firms having 10 years' experience in all aspects of the fabrication and installation of similar systems shall be allowed to perform the work.
- D. The work specified herein, and in each of the allied sections, shall be accomplished by a single Audiovisual Contractor experienced in the design, fabrication, installation, commissioning and warranty contract management of systems such as those described in each section.
1. The Contractor shall have complete responsibility for systems described herein and shall be the single contract point for the Architect, the Consultant and/or the Owner with respect to all work specified

herein.

2. The Contractor shall maintain the same project manager and field supervisor throughout the installation, and where practical, maintain the same installers.
- E. The Contractor shall supply and install any incidental materials, equipment, software, licensing, etc. needed in order to result in a complete and operable system conforming to the design intent without claim for additional payment, even if such equipment is not specifically listed in the Specification.
- F. All work related to this Specification shall be completed in a professional manner by fully qualified workers.

1.18 RELIABILITY

- A. General: The systems are designed to provide professional quality operation over a period of several years without the need for continual maintenance. Equipment that has a high failure rate is not acceptable for installation as part of the systems.
- B. Warranty: The Bidder shall make known, in writing, at time of Bid any exceptions that might exist between conditions described herein and Bidders policy of warranty. After acceptance of bid, all conditions and requirements of warranty described herein shall apply.
 1. The Contractor shall guarantee all equipment, materials and labor for a period of one (1) year from the date of Substantial Completion.
 2. During the warranty period, within 24 hours of notification, the Contractor shall answer all service calls and requests for information.
 3. During the warranty period, within 48 hours of original notification, the Contractor shall provide emergency service to restore operation of the system, replacing defective materials, repairing faulty workmanship, making temporary repairs, and providing loaner equipment as necessary, all at no charge to the Owner.
 4. The Contractor shall notify the Owner before any service call whether such call is or is not covered under warranty. The Owner may be billed for non-warranty calls. The Contractor shall notify the Owner of any service call or work to be performed for which charges may be incurred before such work commences.
 5. Improper functioning, for warranty purposes, means failure of the system to meet the intentions of the specification because of internal defects. It does not include Owner caused malfunctions such as re-adjustment of the controls, re-tuning of the system, or injury to the system beyond normal wear. Nor does the warranty cover paint, exterior finishes, fuses, lamps (including projection lamps) or associated labor, unless the damage or failure results from defective materials or workmanship covered by the warranty.

6. The Contractor shall take such actions at the time of installation to insure that all equipment is installed in accordance with the manufacturer recommended environmental and electrical operating conditions and requirements. After installation, the Contractor shall be responsible for the repair or replacement of said equipment that the Contractor installs which fails due to environmental or electrical conditions, even if not covered by the manufacturer's warranty. The Contractor shall not be held responsible for damages due to changes in environmental conditions, which occur after the date of Substantial Completion.
7. Unless otherwise directed, the Contractor shall activate all manufacturer warranties in the Owner's name. The start date of the warranties shall be the date of Substantial Completion.
8. If the Contractor has modified certain components, the manufacturer warranty may be voided. In this case, the Contractor is responsible for providing warranty coverage equal to that of the manufacturer.
9. Certain subsystems and system components may require installation by authorized representatives in order for the complete manufacturer warranty to apply. If this pertains to any subsystem or component for this project, it is the Contractor's responsibility to make arrangements for the complete manufacturer warranty to apply. These arrangements are to be at no additional cost to the Owner.
10. As part of the Bid Response, the Contractor shall provide the Owner with a proposal to extend the Warranty to cover Year 2, Year 3 and Year 4 of operation. These offerings are to include all parts and all labor; all conditions and restrictions listed above apply.

1.19 PROTECTION OF PERSONS AND PROPERTY

- A. Safety Precautions and Programs: The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. This requirement applies continuously 24 per day during construction of the Project.
- B. Safety of Persons and Property: The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
 1. Employees on the Work and other persons who may be affected thereby.
 2. The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors and vendors.

1.20 LIMITATION OF LIABILITY

- A. The Contractor's entire liability under the Delay in Completion Agreement, including liability arising out of the Products purchased or services performed shall be limited to the total value of the Agreement. Regardless of the legal or equitable basis of any claim or of actual notice, neither the Contractor nor the Contractor's suppliers shall be liable for indirect, special, consequential, or incidental damages. Any claim by the Owner shall be brought within one year of the date of the circumstance of event giving rise to the claim. If the Contractor's performance under this Agreement, or of any obligation here under, is interfered with by reason of any circumstances beyond the Contractor's reasonable control, including, without limitation, fire, explosion, power failure, acts of God, war, revolution, civil commotion, or acts of public enemies, any law, order, regulation, ordinance, or requirement of any government or legal body or any representative of any government or legal body; labor unrest, including, without limitation, strikes, slowdowns, picketing or boycotts; then the Contractor shall be excused from its performance on a day-for-day basis to the extent of such interference.

1.21 SUBMISSION FOR PUBLICATION

- A. Prior written consent from the Owner is required before submitting any information about this project for publication or award. This shall include, but not be limited to, photographs, descriptions, drawings, renderings, equipment lists, or any other information regarding the project. If written consent is provided by the Owner, any submission for publication or award must properly credit the Owner, Architect, and Consultant.

PART 2 PRODUCTS

2.1 GUIDELINES

- A. Active Equipment - All active AV equipment shall be furnished by the Contractor selected by the Owner. All active electronics shall be contractor furnished, contractor installed (CFCI).
- B. Infrastructure Devices - All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.
- C. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer's published specifications.
- D. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the Consultant about any such items shall be made prior to the ordering and installation.
- E. Quantities - Confirm quantities on final Contract Documents. If Contract

Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

- F. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories, software, licenses, etc. necessary for complete and working system meeting design intent of specifications.
- G. Balanced Lines - Unless specifically directed otherwise, wire all line and microphone level circuits as balanced with respect to signal ground. For products without balanced inputs or outputs, provide high quality balancing transformers with proper level, shielding, and impedance characteristics. Assure all audio levels arriving and leaving matrix and routing switchers are equal to the manufacturer's recommended input audio level. If required, use Edcor Electronics (www.edcorusa.com) products or equivalent for level matching.
- H. Keys - Provide five (5) sets of keys for any AV system product requiring keys.
- I. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.
- J. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.
- K. Security Screws - Use Middle Atlantic HTX screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do not use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.
- L. Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.
- M. Wireless Microphones - Coordinate frequency selection with other radio-frequency sources in the area and with manufacturer's recommendations.
- N. Control System Programming:
 - 1. Program each user interface to provide simple, intuitive control of all basic AV functions including: program and speech volume levels, video source and destination routing, screen and lift control, AV

system power and external media player transport functions.

2. Utilize Infocomm International's "Dashboard for Controls" concept for touch panel layout unless directed otherwise by Owner.
 3. Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.
 4. Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
 5. After programming is approved, all control system code and programming, including touch panel code and graphics, will become property of Owner. AV Contractor shall provide Owner both source and compiled code on CD-R disc. Or other approved storage medium.
 6. If requested by Owner, one (1) control system review/update shall be conducted at no additional cost to Owner.
- O. Audio System Programming - Contractor shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both source and compiled code on CD-R disc or other approved storage medium.
- P. Projection Screens - For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor, and include additional black drop as appropriate considering screen size and mounting height.
- Q. AV Equipment Racks:
1. Provide blank faceplate in any area marked BLANK in drawings.
 2. Provide shelf for mounting of any device for which rack mount kit is not available.
 3. Provide one (1) Panelcrafters designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to Consultant for approval of final plate design prior to purchasing and installation.
- R. AV Floor Boxes:
1. Clean floor boxes of all dust and debris prior to installation of any active or connectorized plate.

2. Any floor box with active or connectorized AV plates found to have any dust, debris or water in bottom of box are subject to replacement of all plates and components. A re-test of all associated components must be completed.

S. AV Design Bid and Substitutions

1. System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
2. Bid AV system with products specified in Base Bid section below unless noted otherwise from Owner.
3. No substitutions will be allowed without prior submission of Request for Substitution and approval from Consultant specific to proposed manufacturer and model numbers
 - a. All requested substitutions need to meet or exceed performance of devices listed in Part 2. For each request, provide manufacturer's published specifications to verify performance and explain functional and cost impact.
 - b. Evaluation and approval of substitution requests will be performed by Consultant.
4. Equipment listed in Part 2 is based on performance criteria to meet Owner design requirements.

2.2 AV ACTIVE PRODUCTS

- A. AV active product selection shall be open to Integrator's design for each system based upon the requirements communicated by Owner
- B. The following are major active products for Lobby Digital Signage System:
 1. Digital Signage Player (DS)
 2. Flat Panel Display (FPD)
- C. The following are major active products for Skills & Tasks Classroom AV Presentation Systems:
 1. Integrated Presentation Matrix Switcher (MSW)
 2. Digital Receiver (RX)
 3. Video Projector (PRJ)
 - a. Repurpose Owner furnished projector

- b. Provide one (1) equivalent projector
- 4. Ceiling Loudspeaker (S)
- D. The following are major active products for Debrief Room AV Presentation Systems
 - 1. Digital AV Twisted Pair Transmitter (TX)
 - 2. Integrated Presentation Matrix Switcher (MSW)
 - 3. Digital AV Twisted Pair Receiver (RX)
 - 4. Wall Control Panel (WCP)
 - 5. Flat Panel Display (FPD), 82" HD minimum.
 - 6. Ceiling mounted Microphone (MIC)
 - 7. Ceiling mounted PTZ IP Camera (CAM)
 - 8. Room Schedule Panel (RSP)
- E. The following are major active products for Patient Flex and Home Health Medical Simulation AV Systems:
 - 1. Ceiling mounted PTZ IP Cameras (CAM-PTZ)
 - 2. Ceiling mounted Fixed Focus Camera (CAM-FF)
 - 3. Ceiling mounted Microphone (MIC)
- F. The following are major active products for the Control Room (provision for seven stations).
 - 1. Flat Panel Displays (FPD)
 - 2. Touch PCs to run simulation software and control camera and source selection
 - 3. Desktop microphone per station
 - 4. Desktop speakers per station
- G. The following are major active products for Exam Rooms:
 - 1. Ceiling mounted PTZ IP Cameras (CAM-PTZ)
 - 2. Ceiling mounted Microphone (MIC)
 - 3. Ceiling mounted Loudspeaker (S)

2.3 WIRE AND CABLE

- A. Interconnect Wiring - Wire and cable shall be new and unused. Cable shall be installed splice-free in all cases. Where splices must occur, other than at terminal points of wiring, they must be made with approved connectors and screw terminals in totally enclosed junction boxes. Approval must be obtained in writing from the Consultant before such splices are made.
- B. Wire not installed in equipment racks, nor portable, nor installed in conduit, shall meet all fire and other applicable codes per NEC.
- C. Bulk Wire - Wire shall be by Belden, West-Penn or Liberty AV.
 - 1. Low-Z loudspeaker wire shall be stranded, twisted pairs, #12 each wire for low-frequency, high-frequency and full range loudspeaker.
 - a. Belden 6000UE
 - b. West-Penn 25227B
 - c. Liberty AV 12-2C-TTP
 - 2. Low-Z loudspeaker wire shall be stranded, twisted pairs, #10 wire for sub-woofers.
 - a. Belden 6T00UP
 - b. West-Penn 25210
 - c. Liberty AV 10-2C-TTP
 - 3. Hi-Z loudspeaker wire shall be stranded twisted pairs, #16 each wire.
 - a. Belden 6200PE
 - b. West-Penn D25291
 - c. Liberty AV 16-2C-P
 - 4. Microphone level wire, installed but not portable, and wire for line-level circuits and inter-amplifier wire shall be 1 pair 22 AWG stranded, twisted, and shielded.
 - a. Belden 6500PE
 - b. West-Penn D25291
 - c. Liberty AV 22-1P-EZ
 - 5. HDBaseT AV transport cable shall be stranded #23 4-pair conductor overall shielded Category 6A Cable.

- a. Belden AV6SHP
 - b. West-Penn 254246F
 - c. Liberty AV 24-4P-L6SH
6. TV, Video and RF cable shall be RG-6/u or better.
- a. Belden 1695A
 - b. West-Penn 2563050
 - c. Liberty AV 18-CMP-VID-COAX
7. Component video cable shall be five conductor mini-flex coaxial.
- a. Belden 1279P
 - b. West-Penn WP258255
 - c. Liberty AV RGB5C-25-CMP
8. Control equipment wire and data cable shall be stranded wire of gauge and number of conductors as required by the manufacturer of the equipment furnished.
9. Wire for all other devices shall be according to the recommendation of the device manufacturer.
- D. Pre-Terminated Cable Assemblies
1. HDMI cable shall be retention locking High Speed type in appropriate length for application.
 - a. Liberty AV HD 1000 Series
 - b. Crestron CBL-HD-DVI Series
- E. Connectors - All AV connectors shall be of the quantity and type as required for proper and durable operation, and signal transmission of the electrical characteristics for associated circuitry.
1. Provide strain relief for each and every connector.

PART 3 EXECUTION

3.1 INSTALLATION

A. General Guidelines

1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.

2. Material and Labor - Provide specified products and other incidental equipment, materials, appliances, software, licensing, tools, labor and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge of AV infrastructure and active systems installation.
 3. Documents at Job Site - Keep following documents at job site during entire construction period:
 - a. Complete Specifications and Drawings
 - b. Approved Shop Drawings
 - c. Approved Product Data
 - d. Progress Set of Project Record Documents
 4. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
 5. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
 6. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
 7. Coordinate installation of AV infrastructure and active equipment with other trades in order to follow project schedule.
 8. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.
- B. Labeling
1. Equipment Labels - Contractor shall provide engraved lamicoïd labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch

white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:

- a. Line 1 – Generic name of device, such as MIXER, AMPLIFIER, SWITCHER, etc.
 - b. Line 2: Schematic designation of device, such as AV-MSW-1
 - c. Reconcile naming convention to schematic designation provided on approved shop drawings
2. Control Labels – Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
 3. Terminal Strip Labels - Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
 4. Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.
 5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
 - a. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.
- C. Power and Grounding
1. Power Coordination – Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to audio visual systems. Before installation, verify load requirements for systems as accepted.
 2. Bus Bars - Install 1-inch by ¼-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or

larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 16) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

D. Equipment Racks

1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use "whisper" type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.
2. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length ¾-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with Velcro cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.
3. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
4. Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.

E. Wiring

1. Wiring Standards - Execute wiring in strict adherence to best AV engineering standards and practices.
2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or "Skotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.
3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated Velcro wrap ties.

4. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
5. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.
6. Hum Prevention - Ensure that electromagnetic and electrostatic hum is at inaudible levels. For line level signals, float cable shields at the output of the source device. Do not cut or remove shield conductors; fold back unconnected shields over cable jacket and cover with clear heat-shrink tubing. Do not obstruct cable labels.
7. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.2 STORAGE AND HANDLING

- A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.
- B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.
- C. Schedule delivery to minimize delays in the project.
- D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.3 WARRANTY

- A. Refer to Division 1
- B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:
 1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
 2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
 3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.

4. During warranty period, provide a maximum of four (4) preventative maintenance follow-up calls per Owner request at no additional cost to Owner.
 5. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
 6. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
 7. Extended Manufacturer's Warranties – Identify products with manufacturer's warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
 8. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.
- C. Extended Warranty - Warranty - Provide cost to extend complete AV system warranty from one (1) year to four (4) years in annual increments. Included a list of all provided services including maintenance schedules.

3.4 INITIAL TESTS

- A. Purpose - These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).
- B. Testing Standards – Perform testing in accordance with ANSI, Infocomm and AV9000 standards.
- C. Prior to delivery to the jobsite, the system shall be staged completely in the Contractor's shop. A test of the AV system, with peripheral equipment and working control system programming shall be scheduled, and the Owner and/or the Consultant may elect to inspect the staging testing. A written report shall be prepared and signed by qualified individual described above, using the Staging Checklist contained in Part 4 - Appendices. Not all tests may apply.
- D. The Contractor shall provide a list of the calibrated equipment that will be used on the performance tests in the Staging and Commissioning Checklists, along with the calibration date and serial numbers for each. Refer to the generic list of instrumentation below:
 1. Sensitive AC voltmeter, -80 dBu sensitivity, 20-30 kHz response, able to measure signal to noise ratio, THD, electrical audio levels within the system. Note that some systems require measurements up to 100 volts and may require an external pad.

2. Sound Pressure Level Meter, ANSI Type II, with A and C weighting filters, fast or time-averaged.
 3. Audio Signal generator, 20-30 kHz, sine wave, pink noise.
 4. Amplified loudspeaker 100 mm producing 60 dBA at one meter, and 70 dBA at one meter, pink noise, sine wave, speech files.
 5. 200 MHz oscilloscope, with TV sync.
 6. Analog Video Signal Generator NTSC/PAL, plus computer patterns at all required resolutions and refresh rates required for the systems under test. For systems with composite video, include PLUGE pattern.
 7. Digital Video Signal Generator for computer patterns for all resolutions and refresh rates required for the systems under test, HDMI/DVI.
 8. Quantum Data 780 Video Test Instrument, with HDMI Cable, ACA Passive Monitoring, Network Analyzer options installed, and applicable HDMI cables.
 9. The ability to measure STI-PA (source and analyzer).
 10. Colorimeter/luminance meter, 10% accuracy.
 11. Infrared Thermometer.
 12. Test media with known levels (audio, video, etc.).
 13. AC/DC Multimeter.
 14. Light meter, lux/foot candles.
 15. AC Outlet tester.
 16. Cable sets, cable assemblies, adapters as required to sample and measure in-or out of circuit as required.
- E. Inspection - Verify prior to beginning actual tests and adjustments on systems”
1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
 2. Cables dressed, routed, and labeled, connected with proper polarity.
 3. Insulation and shrink tubing in place.
 4. Dust, debris, solder splatter, etc. removed.
 5. Proper frequency settings (or modules) at crossovers and controllers.

6. All equalizer bands and tone controls set for flat frequency response.
 7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.
- F. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). Contractor to document measurements.
- G. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Staging Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.
- H. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Consultant. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.5 FINAL TESTS AND ADJUSTMENTS

- A. Purpose - These tests are to be witnessed by Consultant to determine if system is complete and functioning as designed and specified. Also, Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.
- B. Timetable - Coordinate with Owner, General Contractor, and Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.
- C. System and Site Conditions –Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant’s arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon Consultant’s arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.
- D. Test Labor - Provide technician familiar with this project’s AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for a minimum of four (4), eight (8)-hour days during Final Tests and Adjustments.

- E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.
- F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.
- G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

3.6 FINAL ACCEPTANCE BY OWNER

- A. Certificate - Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.
- B. General Adjustments – Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.
- C. Input/Output Jack Demonstration – Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.
- D. Inventory - Inventory all installed and portable equipment for correct quantities.
- E. Functional Demonstration – Demonstrate operation of each function of each major piece of equipment.
- F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.
- G. Final Equipment Settings – Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.
- H. Security Inspection – Inspect equipment for security from tampering (covers, shaft-locks, etc.)
- I. Review of Labels – Review installed labels on cables, equipment, controls, and terminal strips.

3.7 OWNER TRAINING

- A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments.

Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

- B. Contractor shall record training sessions, edit into searchable chapters and include recorded media in Operation and Maintenance Manuals.

3.8 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

- A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION

SECTION 28 31 00.UT (PREVIOUSLY SECTION 16721) - FIRE ALARM AND SMOKE DETECTION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section specifies the requirements for furnishing and commissioning a fully functional addressable fire alarm and voice evacuation system with full interface with other related systems. Work shall include, but not limited to, the following.
 - 1. Fire alarm control and annunciator panels
 - 2. Manual fire alarm stations
 - 3. Audible and visual alarm notification devices
 - 4. System acceptance testing and commissioning

1.2 REFERENCES

- A. NFPA 101 - Safety to Life from Fire in Buildings and Structures
- B. NFPA 13 - Installation of Sprinkler Systems
- C. NFPA 20 – Installation of Stationary Pumps
- D. NFPA 70 - National Electric Code
- E. NFPA 72 - National Fire Alarm Code
- F. NFPA 90A – Installation of Air-Conditioning and Ventilating Systems
- G. NFPA 92A – Smoke- Control Systems
- H. UL 864 - Control Units for Fire Protective Signaling Systems
- I. ADA Accessibility Guidelines (ADAAG)
- J. Texas State Insurance Code
- K. Texas Accessibility Standards (TAS)
- L. Local-city Ordinances
- M. International Building Code
- N. All electronic equipment shall comply with all FCC limits governing radio frequency electromagnetic interference and be so labeled.
- O. None of the terms or provisions of this specification shall be constructed as waiving any of the rules, regulations or requirements of Codes.

1.3 SYSTEM DESCRIPTION

- A. The fire alarm system is existing to remain. Devices will be removed and reinstalled in new locations.
- B. The automatic fire detection and alarm system shall consist of a main fire alarm control panel, local control panel nodes, operator workstation, graphics terminal, audio control panel, printer, remote annunciator, detection devices, audible and visual notification devices, remote devices, and manual stations wired in accordance with the schedule on the Drawings and shall function as specified herein. The system shall use supervised multiplex data communications circuits, close loop initiation circuits, individual zone supervision, and individual audible and visual alarm circuit supervision.
- C. The system shall have sufficient capacity to incorporate all equipment and perform all functions as per intent of the specifications and Drawings. The system shall have an overall 20 percent spare capacity that includes but not limited to communication network, terminal strips, amplifier, batteries, etc., reserved for future expansion.

- D. The system shall be capable of being programmed on site for downloading, uploading or editing operating sequence or programming to accommodate and facilitate building parameter changes or changes as required by codes.
- E. Type and quantity of signals, which are expected to be transferred and monitored by existing campus command/dispatch center, shall be verified during design phase. Compatibility issue also needs to be addressed.

1.4 QUALITY ASSURANCE

- A. The system shall be installed by competent mechanics, regularly employed by a Fire Alarm contractor with full responsibility for proper operation of the system including debugging and proper calibration of each component in the entire system. The Contractor shall be with 3 years or more experience with installation of this type. The fire alarm technician shall be licensed by State Fire Marshal in order to install, certify and service the fire alarm system. Supplier shall be licensed by State Fire Marshal in order to sell fire alarm product, and shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- B. The complete Fire Alarm and Smoke Detection System installation shall be in strict accordance to the national and local electrical codes and the electrical Section of these specifications. The equipment shall be manufactured by a manufacturer who has been engaged in this type of production (both hardware and software) for at least ten years. The product shall be UL listed under standards 864 (Control Units for Fire Protective Signaling Systems).

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver fire alarm system components in factory-fabricated containers.
- B. Store in a clean, dry space and protected from the weather.
- C. Handle control and annunciator panels carefully to avoid damage to material components, enclosure and finish.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL

- A. Existing to remain.

2.2 PERIPHERAL DEVICES

- A. All detection devices shall contain an integral alarm LED. All addressable detectors shall be individually identifiable by zone. Mounting bases shall be provided by life safety contractor, included with detector as a complete assembly.
- B. The addressable programmable interface module is designed to provide an interface for direct-shortening contact devices. The unit is used with water flow switches, pressure switches, tamper switches on OS&Y valves, and other contact closure devices. The unit shall electrically supervise wiring to contacts via EOLR provided by life safety contractor.
- C. The addressable manual pull station shall operate on any addressable detection circuit. The addressable manual pull station shall be individually annunciated on the control panel. The unit shall be double-action initiated, having latching relays.
- D. Alarm bells shall be of the polarized 24-Vdc type. The mechanisms shall be fully enclosed and dust-proof. They shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface that is free from vibration.
- E. Alarm horns shall be of the polarized 24-Vdc type. The mechanisms shall contain an aerospace-grade aluminum diaphragm; blued, tempered, and polished armature, and tungsten contact points, all housed in a die-cast frame-and-grill assembly. They shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface and capable of being surface, semi flush, or flush mounted.

- F. Alarm speakers (non-ceiling mounted) shall be of the polarized 24-Vdc type. The speaker shall have 70.7 VRMS inputs and have field-selectable power taps from 1/8 watt to 8 watts. Speaker shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Speaker shall have vandal-resistant red grill faceplate. Speakers shall be designed to be mounted on a wall or other suitable rigid surface and shall be capable of being surface, semi flush, or flush mounted.
- G. Alarm speakers (ceiling mounted) shall be of the polarized 24-Vdc type. The speaker shall have 70.7 VRMS inputs and have field selectable power taps from 1/8 watt to 8 watts. Speaker shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Speaker shall have 4-inch cone and shall have 7.25-inch-diameter circular metal faceplate with white enamel finish. Speakers shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface and be capable of being flush mounted.
- H. Alarm speakers (extra loud) shall be of the polarized 24-Vdc type. The speaker shall have 70.7 VRMS inputs and have field-selectable power taps from 0.9 watt to 15 watts. Speakers shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Peak speaker output shall be 121 dB at 4 feet, 15 watt or 111 dB at 10 feet, 15 watt. Speaker shall have high-efficiency compression driver with re-entrant horn, and shall have a baked gray epoxy finish. Speakers shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface, and be capable of being surface mounted.
- I. Strobe lights shall produce a minimum of 75 candelas at approximately one flash per second with continuously applied voltage. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40 percent. Rated voltage shall range from 18 to 31.2 volts for nominal 24-Vdc models. The xenon flash tube and associated circuitry shall be enclosed in a translucent white polycarbonate lens with "fire" inscribed on the lens. Plate color shall be red.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the areas and conditions under which the fire alarm system is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install system and materials in accordance with the manufacturer's written instructions, drawing set, and details, the applicable requirements of the NEC and NFPA 72, and specifications in Division 26.
- B. Junction boxes used as back boxes for fire alarm system field devices shall be 4-inch square with 2 1/8-inch minimums in depth. Install adapter plates and extension rings where required. Junction boxes for concealed conduit system shall be flush mounted.
- C. Mount outlet box for electric door holder to withstand 80-pound-pulling force.
- D. Upon initial installation, all fire alarm detection devices shall have the original plastic dust covers installed. Dust covers shall not be removed until installation is completed and the system is ready for test.
- E. Each conductor shall be identified as shown on the shop drawings by attaching permanent alphanumeric wire markers within 2 inches of the wire termination at both ends. Marker legends shall be visible. Junction box and pull box covers shall be painted yellow or have embossed adhesive tape labeling that is minimum 1/4-inch white letters over a yellow background with text "Fire Alarm". Install end-of-line device in box with text "End-of-Line" or "EOL". Number-code or color-code conductors, appropriately and permanently for identification and servicing of system.
- F. Splices shall only be made on terminal strips. All fire alarm wiring shall be installed in raceways as per drawing. All external wiring shall be color-coded and shall not be installed in the same outlet box, junction box, or conduit with conductors of lighting or power systems.
- G. Locate and install the detector assembly for optimum response time and easy accessibility.

3.3 TESTING

- A. The entire fire alarm system shall be field tested in accordance with NFPA standards and other applicable standards in the presence of the Construction Inspector. Inspection and test method shall be in compliance with NFPA 72. Inspection and test record forms that are recommended by NFPA 72 shall be utilized. Results of such testing shall be recorded on forms approved for the purpose, certified and submitted to the Construction Inspector prior to final acceptance.
- B. All test equipment; instruments, tools, and labor that required conducting the system tests shall be provided by the Contractor. The following equipment, but not limited to, shall be a minimum for conducting such tests.
 - 1. Ladders and scaffolds as required for access all field devices.
 - 2. Multi-meter for reading voltage, current and resistance.
 - 3. Intelligent device programmer/tester.
 - 4. Laptop computer with programming software for any required program revisions.
 - 5. Two-way radios, flashlights, smoke generation devices and supplies.
 - 6. Spare printer paper.
 - 7. Decibel meter.
- C. Perform all electrical and mechanical tests required by the equipment manufacturer's certification form. In addition, measure and adjust each of the ionization detectors to the maximum stable sensitivity setting. This must be performed with the detector at its operational environmental conditions in the area. Bench settings are not acceptable. All test and report costs shall be in the contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, of which one copy will be registered with the equipment manufacturer. The report shall include, but not be limited to:
 - 1. A complete list of equipment installed and wired.
 - 2. Indication that all equipment is properly installed and functions and conforms to these Specifications.
 - 3. Wiring runs shall be tested for continuity, short circuits and ground before system is energized. Resistance, current and voltage reading shall be made as work progresses.
 - a. A systematic record shall be maintained for all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates, and witnesses.
 - b. The Owner shall be notified before the start of the required tests. All items found at variance with the applicable drawings and/or specifications during testing and inspection by the Owner, shall be corrected by Contractor at no additional cost to the Owner.
 - c. Test reports shall be delivered to the Owner when completed.
 - 4. Test of individual zones as applicable.
 - 5. Technician's name, certificate number, and date.
- D. Final Acceptance Test (FAT)
 - 1. The FAT shall be conducted in the presence of the Owner and under the supervision of the Manufacturer. Prior to FAT, the Owner shall be provided drawings showing the correct address for all addressable alarm initiation devices. The address shall be shown in their respective locations for the device on drawings. Signals shall be sequentially numbered as the address of the controlling module.
 - 2. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, short, and ground fault for intelligent analog signaling circuit.
 - b. Open, short, and ground fault for intelligent digital signaling circuit.
 - c. Open, short, and ground fault for network signaling circuit.
 - d. Intelligent device removal.
 - e. Type of device miss-match the address ID.
 - f. Polarity check.
 - 3. System indications shall be demonstrated as follows.
 - a. Correct message display for each alarm input at the remote control panel, central control panel and operator's workstation graphic display.

- 1) Correct annunciator light for each alarm input at each annunciator and color graphic of operator's workstation.
 - 2) Correct printer logging for all system activity.
4. In the event of system failure to perform as specified and programmed during the FAT, the test shall be terminated at the discretion of the Owner.
- a. The Contractor shall retest the system correcting all deficiencies and providing test documentation to the Owner without additional cost to the Owner.
 - b. In the event that software changes are required during the FAT, a utility program shall be provided by the system manufacturer to compare the edited program with the original. The utility shall field a printed list of the changes and all system functions, inputs and outputs affected by the changes. The items listed by the program shall be the minimum acceptable to be retested before calling for resumption of the FAT. The printed list and the printer log of the retesting shall be submitted before scheduling of the FAT.
 - c. The Owner may elect to require the complete FAT to be performed again if, in their opinion, modifications to the system hardware or software warrant complete retesting.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Include services of factory-certified technicians to supervise installation, adjustments, calibrations, final connections, and system testing. A representative of the manufacturer shall instruct the Owner and demonstrate the system after the Owner has occupied the building.
- B. As-built drawings shall be provided upon acceptance of the system with quantities per contract document.

END OF SECTION 28 31 00

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