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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition and removal of selected portions of building.
B. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.
B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.5 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
   1. Before selective demolition, Coordinate with the Owner, items that the Owner will remove the following items:
C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
E. Storage or sale of removed items or materials on-site is not permitted.
F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.
G. Arrange selective demolition schedule so as not to interfere with Owner's operations.
1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ASSE A10.6 and NFPA 241.

C. Protect items scheduled for reuse from damage during the construction period.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. 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.

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

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.

3.3 PROTECTION

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

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

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   4. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
   5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   6. Dispose of demolished items and materials promptly.

B. 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.

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

D. 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.

E. 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, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. 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
PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
   2. Disposal of materials.
   4. Identification of utilities.
   5. Salvaged items.
   6. Protection of items to remain as indicated on Drawings.
   7. Relocate existing equipment to accommodate construction.

B. Related Sections:

1.02 QUALITY ASSURANCE

A. Perform Work in accordance with State of Nevada Public Work’s standard.

1.03 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule work to coincide with new construction.

C. Perform noisy, malodorous, dusty, work:
   1. As allowed by Owner.

D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.04 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Conduct demolition to minimize interference with adjacent occupied building areas.

C. Coordinate demolition work with other trades.

D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

E. Shut-down Periods:
   1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
   2. Keep shut-down period to minimum or use intermittent period as directed by Owner.
   3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.
F. Identify salvage items in cooperation with Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.

C. Verify termination points for demolished services.

3.02 PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor’s employees, and existing improvements to remain.

B. Temporary egress signage and emergency lighting

3.03 DEMOLITION

A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.

B. Remove abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

D. Disconnect electrical systems in walls, floors, and ceilings in areas of demolition.

E. Reconnect equipment being disturbed by renovation work and required for continue service to nearest available panel.

F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.

G. Install temporary wiring and connections to maintain existing systems in service during construction.

H. Perform work on energized equipment or circuits with experienced and trained personnel.

I. Remove, relocate, and extend existing installations to accommodate new construction.

J. Repair adjacent construction and finishes damaged during demolition and extension work.
K. Remove abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.

L. Clean and repair existing equipment to remain or to be reinstalled.

M. Protect and retain power to existing active equipment remaining.

N. Cap abandoned empty conduit at both ends.

O. Perform Work in accordance with State of Nevada Public Work's standards.

3.04 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.

B. Tag unused circuits as spare.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated typed directories where more than three circuits have been modified or rewired.

3.05 SALVAGE ITEMS

A. Remove and protect items indicated on Drawings or otherwise directed by Owner to be salvaged and turn over to Owner.

B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.06 REUSABLE ELECTRICAL EQUIPMENT

A. Carefully remove equipment, materials, or fixtures which are to be reused.

B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.07 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove demolished materials as work progresses. Legally dispose.

C. Keep workplace neat.

3.08 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
B. Do not permit traffic over unprotected floor surface.

END OF SECTION
SECTION 03 30 53
MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1  GENERAL

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

1.2  ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Design Mixtures: For each concrete mixture.

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

PART 2  PRODUCTS

2.1  CONCRETE, GENERAL
A. Comply with ACI 301 (ACI 301M).
B. Comply with ACI 117 (ACI 117M).

2.2  STEEL REINFORCEMENT
A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3  CONCRETE MATERIALS
A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates [and cementitious materials] that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
B. Regional Materials: Concrete shall be manufactured within 500 miles of Project site.
C. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type V.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
E. Air-Entraining Admixture: ASTM C 260/C 260M.
F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

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

2.4 RELATED MATERIALS

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

B. Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick; or plastic sheet, ASTM E 1745, Class C.

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

2.5 CURING MATERIALS

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

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

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

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 CONCRETE MIXTURES

A. Normal-Weight Concrete:
   1. Minimum Compressive Strength: 4500 psi at 28 days.
   2. Maximum W/C Ratio: 0.50.
   3. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
   4. Slump Limit: 4 inches plus or minus 1 inch.
   5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.
2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
   1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMWORK INSTALLATION

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

3.2 EMBEDDED ITEM INSTALLATION

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

3.3 VAPOR-RETARDER INSTALLATION

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
   1. Lap joints 6 inches and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

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

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

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.6 CONCRETE PLACEMENT

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

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

C. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
3.7 FINISHING UNFORMED SURFACES

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

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
   1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

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

E. Slip-Resistive Broom Finish: Apply a slip-resistant finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

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

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

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

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

B. Tests: Perform according to ACI 301 (ACI 301M).
   1. Testing Frequency: Obtain one composite sample for each day’s pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd.
   2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

END OF SECTION
SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Access doors and frames for walls and ceilings.

1.2  ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For each type of access door and frame and for each finish specified.
C. Product Schedule: For access doors and frames.

PART 2  PRODUCTS

2.1  MANUFACTURERS – WALL AND CEILING UNITS

A. BAR-CO, Division of Alfab.
B. Bilco Company.
C. JL Industries.
D. Karp Associates, Inc.
E. Milcor.
F. Acudor.
G. Cesco.

2.2  ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
   1. Description: Face of door flush with frame, with exposed flange and concealed piano hinge.
   2. Locations: Wall and ceiling
   3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage factory primed.
   4. Frame Material: Same material, thickness, and finish as door.
   5. Latch and Lock: Cam latch, key operated.

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.
C. Frame Anchors: Same material as door face.

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

2.4 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:
   1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
   2. Keys: Furnish two keys per lock and key all locks alike.

2.5 FINISHES

A. 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 written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION
SECTION 08 41 13
ALUMINUM ENTRANCES AND STOREFRONTS

PART 1  GENERAL

1.1  WORK INCLUDED

A. Aluminum doors and frames.

B. Door hardware.

1.2  PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section, including floor pivots.

1.3  RELATED WORK

A. Section 08 56 70 - Sound Control Windows

B. Section 08 71 00 - Door Hardware.

C. Section 08 80 00 - Glazing.

1.4  REFERENCES

A. AA - Aluminum Association.

B. ANSI/ASTM A386 - Zinc Coating (Hot Dip) on Assembled Steel Products.

C. ANSI/ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

D. ANSI/ASTM E283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.


G. SSPC - Steel Structures Painting Council.

1.5  SYSTEM DESCRIPTION

A. Aluminum entrances and storefront system includes tubular aluminum sections, shop fabricated, factory finished, vision glass, related flashings, anchorage and attachment devices, for both interior and exterior installation.

1.6  PERFORMANCE REQUIREMENTS

A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with the Uniform Building Code and as measured in accordance with ANSI/ASTM E330.

B. Limit mullion deflection to 1/200 or flexure limit of glass; with full recovery of glazing materials.
C. System to accommodate, without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

D. Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ANSI/ASTM E283.

E. Water Leakage: None, when measured in accordance with ASTM E331 with a test pressure difference of 8 psf.

F. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.

G. System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees F over a 12-hour period without causing detrimental affect to system components.

H. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.7 SUBMITTALS

A. Submit under provisions of Sections 01 33 00 and 01 33 23.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work and expansion and contraction joint location and details.

C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass, door hardware, internal drainage details and installation instructions.

D. Submit two samples, 5 x 10 inches, minimum in size, illustrating aluminum and, glass and glazing materials.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.8 QUALIFICATIONS

A. Perform work in accordance with AAMA-SFI and Metal Curtain Wall, Window, Storefront and Entrance Guide Specs.

B. Manufacturer: Company specializing in manufacturing aluminum glazing systems or glass entry doors with minimum five years documented experience.

C. Design structural support framing components under direct supervision of a Professional Engineer licensed in the State of Nevada.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 66 00.

B. Protect pre-finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants when ambient temperature is less than 40 degrees F during and 48 hours after installation.
1.11 FIELD MEASUREMENTS
   A. Verify that field measurements are as indicated on drawings.

1.12 COORDINATION
   A. Coordinate work under provisions of Section 01 31 13.
   B. Coordinate with work of Section 28 13 00 – Security Access System.
   C. Hardware shall be by manufacturers listed in 08 71 00.

1.13 WARRANTY
   A. Provide five-year warranty under provisions of Section 01 78 36.
   B. Warranty: Include coverage for complete system for failure to meet specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Basis of design: Center Glazed System: Arcadia AG451.
   B. Basis of design: Offset Glazed System (with silicone corner): Arcadia AFG451.
   D. Kawneer.
   E. Substitutions: Under provisions of Section 01 25 13.

2.2 MATERIALS
   A. Extruded Aluminum: ANSI/ASTM B221; 6063 alloy, T5 temper.
   C. Fasteners: Stainless steel.
   D. Shop and Touch-Up Primer for Steel Components: SSPC 15, Type 1, red oxide.

2.3 COMPONENTS
   A. Frame: 2 x 4 1/2 inch nominal dimension; flush glazing stops; drainage holes; internal weep drainage system.
   B. Aluminum Doors: 1-3/4 inches thick, 3-1/2 (plus or minus 3/16 inch) wide top rail, 3-1/2 (plus or minus 3/16 inch) wide vertical stiles, 10 (plus or minus 1/4 inch) wide bottom rail; bevelled glazing stops.
   C. All Glass Doors: 1/2 inch thick; 2-1/2 inch wide top rail, 12 inch wide bottom rail or minimal top and bottom edge channels.
   D. Sills: 12 inch deep; extruded aluminum; slope for positive wash; one piece full width of opening.

2.4 GLASS AND GLAZING MATERIALS
   A. Glass and Glazing Materials: As specified in Section 08 80 00 and as scheduled on drawings.
2.5 SEALANT MATERIALS
   A. Sealant and Backing materials: As specified in Section 07900.

2.6 HARDWARE
   A. As shown in Section 08 71 00 and including:
      2. Pivots: For manual-operated doors, intermediate type, single-acting, top and bottom. For automatic doors, as supplied by automatic door operator supplier.
      4. Stops: Trimco, wall or floor as required.
      5. Finger Guards: As supplied by door manufacturer.

   B. At all exterior aluminum doors:
      1. Threshold: Extruded aluminum, full width of door opening, ribbed.

2.7 FABRICATION
   A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.
   B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
   C. Prepare components to receive anchor devices. Fabricate anchors.
   D. Arrange fasteners and attachments to conceal from view.
   E. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.

2.8 FINISHES
   A. Interior Exposed Aluminum Surfaces: Class II, clear anodic coating conforming to AA Standard A41.
   B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft.
   C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION
   B. Verify dimensions, tolerances, and method of attachment with other work.
   C. Verify wall openings are ready to receive work of this section.

3.2 INSTALLATION
   A. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   B. Provide alignment attachments and shims to permanently fasten system to building structure.
C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Set thresholds and sills, and secure.

E. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.

F. Install glass in accordance with Section 08 80 00, to glazing method required to meet performance criteria.

G. Install perimeter sealant on both sides of frames.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inches every 3 ft non-cumulative.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 ADJUSTING

A. Adjust work under provisions of Sections 01 75 00.

B. Adjust operating hardware for smooth operation.

3.5 CLEANING

A. Clean work under provisions of Sections 01 74 13 and 01 74 23.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of Section 01 66 00.

B. Protect finished work from damage.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sound control windows with STC ratings of 56 and 59.

1.2 RELATED DOCUMENTS

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

B. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.

C. Section 09 22 16 - Non-Structural Metal Framing.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions.

B. Test Reports: Upon request submit certified test reports from recognized test laboratories.

C. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

D. Provide shop drawings including profiles and installation details.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Acoustical Performance:
   1. The sound control window manufacturer will be required to submit acoustical performance data in the form of up-to-date test reports from an independent testing laboratory indicating the doors to be provided will have the required Sound Transmission Class Rating (ASTM E-90-90).
   2. Owner may at his option order performance tests of installed window assemblies by an independent consultant to verify compliance with the specifications. Any discrepancies shall be repaired or replaced without cost to the Owner.

C. Single-Source Responsibility: Provide sound control windows, including gaskets, hinges and other hardware items essential for sound control as an assembly and by a single firm specializing in producing this type of work for a minimum of ten (10) years.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver material in the manufacturer's original, unopened, undamaged containers with identification labels intact.
B. Shipping:
1. Glass shipped separately to avoid breakage.
2. Easy snap in glass installation on job site.

C. Provide labels indicating brand name, source of procurement, style, size and thickness.

D. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.6 WARRANTY
A. Warranty Period: Two years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Sound Control Windows:
3. Substitutions in accordance with Division 1 requirements.

2.2 SOUND CONTROL WINDOWS

A. Product: All-Con Noise Lock windows by iac acoustics.
1. STC rating: 53 or 59, as indicated on drawings.
2. Size (clear opening): As indicated on drawings.
3. Glazing: 2 layers of laminated glass; STC 59 window consists of 1 pane of 1/2" laminated glass plus an air cavity and an additional pane of 3/8" laminated glass. STC 53 window consists of 1 pane of 1/4" laminated glass plus an air cavity and an additional pane of 1/4" laminated glass.
4. Frame: Cold Rolled Steel frame.

B. Window Frame:
1. Cold Rolled Steel.
   a. Finish Powder coated, color: Manufacturer's Silverplate textured.
2. Acoustically treated frames and seals.
3. Class A-1 ASTM E-84 Nonflammable Sound Silencer™ acoustical frame insert.
4. Width: 10" for STC 59 window; 8" for STC 53 window.

PART 3 EXECUTION

3.1 EXAMINATION
A. Examine openings, substrates, anchorage, and conditions.

B. Immediately inspect shipment for damage during transit i.e., damage caused by fork lifts, stacking, water stains etc. and disclose to delivery driver prior to signing for receipt.

3.2 INSTALLATION
A. Manufacturer’s Instructions:
1. Comply with the instructions and recommendations of the window manufacturer.
3.3 CLEANING

A. Clean surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

END OF SECTION
SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Commercial door hardware for the following:
   1. Swinging doors.
   2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Cylinders specified for doors in other sections.

1.3 RELATED SECTIONS

A. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts.

1.4 REFERENCES

A. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

B. Standards: All hardware specified herein shall comply with the following industry standards:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL10C – Positive Pressure Fire Tests of Door Assemblies.

1.5 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
   1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
      a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
      b. Complete (risers, point-to-point) access control system block wiring diagrams.
      c. Wiring instructions for each electronic component scheduled herein.
   2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:
   1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third-party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Section 01 31 19 with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
   3. Review sequence of operation narratives for each unique access-controlled opening.
   4. Review and finalize construction schedule and verify availability of materials.
   5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring,signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. 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.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Seven (7) years for heavy duty cylindrical (bored) locks and latches.
2. Twenty-five (25) years for manual surface door closer bodies.
1.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
   1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
   1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
      a. Two Hinges: For doors with heights up to 60 inches.
      b. Three Hinges: For doors with heights 61 to 90 inches.
      c. Four Hinges: For doors with heights 91 to 120 inches.
      d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

   2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
      a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
      b. Sizes from 3'1” to 4’0": 5” standard or heavy weight as specified.

   3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
      a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
      b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

   4. Hinge Options: Comply with the following:
      a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

   5. Acceptable Manufacturers:
      a. Hager Companies (HA).
      b. Ives (IV).
      c. Stanley Hardware (ST).
2.3 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
   1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
   1. Acceptable Manufacturers:
      a. Medeco (MC) - X4 Series.
      b. No Substitution.

F. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Key locks to Owner's existing system.

G. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Three (3).
   2. Master Keys (per Master Key Level/Group): Five (5).
   4. Construction Control Keys (where required): Two (2).
   5. Permanent Control Keys (where required): Two (2).

H. Construction Keying: Provide construction master keyed cylinders.

I. Construction Keying: Provide temporary keyed construction cores.

J. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.
2.4 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
   1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
   2. Locks are to be non-handed and fully field reversible.
   3. Acceptable Manufacturers:
      a. Schlage (SC) – ND Series.
      b. No Substitution.

2.5 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.6 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction with dual interlocking plunger design tested to exceed 3000 lbs. of static strength and 350 ft-lbs. of dynamic strength. Strikes tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.
   1. Acceptable Manufacturers:
      a. HES (HS).
      b. Von Duprin (VD).

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
   2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
   3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.


10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

   1. Acceptable Manufacturers:
      a. Von Duprin (VD) - 35A/98 XP Series.
      b. No Substitution.

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

   1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

   2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

   3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

   4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

   5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

   6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

   7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:
   a. LCN Closers (LC) - 4040XP Series.
   b. No Substitution.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2” less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1” less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
   a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Acceptable Manufacturers:
   a. Hager Companies (HA).
   b. Ives (IV).
   c. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:
   a. Hager Companies (HA).
   b. Ives (IV).
   c. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:
   1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
   2. Zero (ZE).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

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

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.
3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.


3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:
1. IV – Ives
2. SC – Schlage
3. VD - Von Duprin
4. MC – Medeco
5. HS – HES
6. LC - LCN Closers
7. RO – Rockwood
8. OT – OTHER
9. ZE - Zero International Inc

**Hardware Sets**

**Set: 1.0**

Doors: 1228

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Code</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinge</td>
<td>5BB1 (size as req.)</td>
<td>626</td>
<td>IV</td>
</tr>
<tr>
<td>1 Cylindrical Lock (classroom)</td>
<td>ND70 H RHO</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>1 Small Format Inter Core</td>
<td>Medeco Keymark SFIC by UNLV Lockshop</td>
<td>26</td>
<td>MC</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>4040XP REG</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>1 Drop Plate</td>
<td>4040XP-18</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>406/409/441CU as required</td>
<td>US26D</td>
<td>RO</td>
</tr>
<tr>
<td>1 Threshold</td>
<td>271A</td>
<td></td>
<td>PE</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>By Frame Mfg.</td>
<td></td>
<td>OT</td>
</tr>
</tbody>
</table>
Set: 2.0

Doors: 1220

3 Hinge 5BB1 NRP (size as req.) 626 IV
1 Cylindrical Lock (classroom) ND70 H RHO 626 SC
1 Small Format Inter Core Medeco Keymark SFIC by UNLV Lockshop 26 MC
1 Drop Plate 4040XP-18PA AL LC
1 Spacer 4040XP-61 AL LC
1 Door Closer 4040XP Hw/PA AL LC
1 Wall Stop 406/409/441CU as required US26D RO
1 Threshold 271A PE
1 Gasketing By Frame Mfg. OT

Set: 3.0

Doors: 1227

3 Hinge 5BB1 NRP (size as req.) 626 IV
1 Cylindrical Lock (storeroom) ND80 H RHO 626 SC
1 Small Format Inter Core Medeco Keymark SFIC by UNLV Lockshop 26 MC
1 Electric Strike 1600-CS 630 HS
1 Door Closer 4040XP Rw/PA AL LC
1 Drop Plate 4040XP-18PA AL LC
1 Spacer 4040XP-61 AL LC
1 Wall Stop 406/409/441CU as required US26D RO
1 Threshold 271A PE
1 Gasketing By Frame Mfg. OT
1 Gasketing 328AA ZE
1 Gasketing 326AA ZE
1 Door Bottom 360AA ZE

Notes: 328 to be mounted on hinge side. 326 to be mounted on head and lock side.

Access control system will be provided and installed by security contractor and will include: Card Reader, power supply, DPS, conduit, junction box, test and termination of the access control system and will interface with all of the electrified products in this hardware set.

Operative Description:
Door normally closed, latched and locked.
Presenting valid credential or key override to unlock.
Lock remains locked when power fails.
Free egress at all times
Door status monitored
**Set: 4.0**

Doors: 1221, 1222, 1223, 1224, 1225, 1226

1 Cylindrical Lock (storeroom) | ND80 H RHO | 626 | SC
1 Small Format Inter Core | Medeco Keymark SFIC by UNLV Lockshop | 26 | MC
1 Electric Strike | 1600-CS | 630 | HS
1 Door Closer | 4040XP REG | AL | LC
1 Kick Plate | K1050 10" BEV SA | US32D | RO
1 Wall Stop | 406/409/441CU as required | US26D | RO

Notes: Hinges, seals and thresholds by STC door mfg. Installation of the hardware to be coordinated with the STC door manufacturer.

Access control system will be provided and installed by security contractor and will include: Card Reader, power supply, DPS, conduit, junction box, test and termination of the access control system and will interface with all of the electrified products in this hardware set.

Operative Description:
Door normally closed, latched and locked.
Presenting valid credential or key override to unlock.
Lock remains locked when power fails.
Free egress at all times
Door status monitored

**Set: 5.0**

Doors: 1227A

1 Rim Exit Device | 99L 06 996L | US26D | VD
1 Threshold | 271A | PE
1 Gasketing | 328AA | ZE
1 Gasketing | 326AA | ZE
1 Door Bottom | 361AA | ZE

Notes: Modify door to receive new hardware. Field verify to fit hardware 328 to be mounted on hinge side. 326 to be mounted on head and lock side.
Set: 6.0

Doors: 1243

1 Electric Strike 1600-CS 630 HS

Notes: Modify opening to receive new hardware. Field verify to fit hardware

Access control system will be provided and installed by security contractor and will include: Card Reader, power supply, DPS, conduit, junction box, test and termination of the access control system and will interface with all of the electrified products in this hardware set.

Operative Description:
Door normally closed, latched and locked.
Presenting valid credential or key override to unlock.
Lock remains locked when power fails.
Free egress at all times
Door status monitored

END OF SECTION
SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass for interior sound control windows, sound control doors and storefront windows and entrance doors.

B. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

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

1.5 WARRANTY

A. Manufacturer's Special Warranty for 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.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Float Glass:
   2. PPG.
   3. Pilkington.
   4. Saint Gobian.
   5. Visteon.

B. Float Glass Fabricators (Tempered, Non-Coated, Insulated):
   1. ACI.
   2. AFGD.
   3. Hehr Glass.
   5. Oldcastle Glass.

C. Custom Laminated/Security Glass:
   2. Hehr Glass.
   4. Oldcastle Glass.

D. Sealants:
   1. Zero/International INO.

E. Substitutions: Under provisions of Section 01 25 13.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
B. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent
C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 LAMINATED GLASS

A. 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.
1. Construction: Laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
2.7  GLAZING SEALANTS

A. General:
   1. Compatibility: 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.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.

2.8  GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

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.

2.9  MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. 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.

PART 3  EXECUTION

3.1  GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

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 length plus width is larger than 50 inches.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

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

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, 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.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 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.

3.4 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.

3.5 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. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 LAMINATED GLASS SCHEDULE

A. Glass Type GL-2: Clear laminated glass with two plies of fully tempered float glass.

1. Minimum Thickness of Each Glass Ply: 1/8".
2. Interlayer Thickness: 0.060 inch.
3. Safety glazing required.

B. Glass Type GL-3: Clear laminated glass with two plies of fully tempered float glass.

1. Minimum Thickness of Each Glass Ply: 3/16"
2. Interlayer Thickness: 0.060 inch.
3. Safety glazing required.

C. Glass Type GL-4: Clear laminated glass with two plies of fully tempered float glass.

1. Minimum Thickness of Each Glass Ply: 3/8"
2. Interlayer Thickness: 0.060 inch.
3. Safety glazing required.
3.7 INSULATING GLASS SCHEDULE

A. Glass Type GL-1: Clear insulating glass.
   1. Overall Unit Thickness: 1 inch
   3. Outdoor Lite: Fully tempered float glass.
   4. Interspace Content: Air.
   5. Indoor Lite: Fully tempered float glass.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Non-load-bearing steel framing systems for interior partitions.
B. Suspension systems for interior ceilings and soffits.

1.2  ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3  INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.
B. Evaluation reports for post-installed anchors and power-actuated fasteners.

1.4  QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association or the Steel Stud Manufacturers Association.

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 on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2  FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

B. Studs and Tracks: ASTM C 645.
   1. Steel Studs and Tracks:
      a. Cemco
      b. Clark Dietrich
      c. Knoor Steel Framing Systems.
2. Minimum Base-Metal Thickness: As indicated on Drawings.
3. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide the following:
   1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: As indicated on Drawings.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0296 inch
   2. Depth: As indicated on Drawings

F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
   1. Clark Detrich RCSD
   2. Cemco RC1-X

G. Sound Isolation Clips: 1 5/8" deep combination of rubber spacer and hat channel clip.
   1. Approved products:
      a. Sound Isolation Company -RSIC-1
      b. Sound Isolation Company -Isomax clips

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
   2. Stud wall isolation strips: As indicated on the documents.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

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

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies. Install isolation strips in accordance with the drawings.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Interior gypsum board.

B. Texture finishes.

1.2  ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2  PRODUCTS

2.1  PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

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

2.2  GYPSUM BOARD, GENERAL

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

2.3  INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M:
   2. Pabco.

   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.


2.6 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.
   1. Texture: Medium orange peel.
PART 3  EXECUTION

3.1  APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C 840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. 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.

E. Prefill open joints, beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for wood paneling.
   3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

3.2  APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

3.3  PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION
SECTION 09 51 23
ACOUSTICAL TILE CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Acoustical tiles for interior ceilings.
B. Fully concealed, direct-hung, suspension systems.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Samples: For each exposed product and for each color and texture specified.
C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
   1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
B. Product test reports.
C. Research reports.
D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance data.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00, to design seismic restraints for ceiling systems.
B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
C. 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: Class A according to ASTM E 1264.
   2. Smoke-Developed Index: 25 or less.
2.2  ACOUSTICAL TILES: ACT -1

A. Basis of design: Armstrong Optima 3159

B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264.

C. Classification: High NRC

D. Color: White.

E. Light Reflectance (LR): 0.90.

F. Ceiling Attenuation Class (CAC): N/A.

G. Noise Reduction Coefficient (NRC): 1.00.


I. Edge/Joint Detail: Square.

J. Thickness: 1.5 inches.

K. Modular Size: 24 by 24 inches.

2.3  METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Manufacturer's standard 15/16" Prelude system, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C 635/C 635M.

2.4  ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.5  METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

PART 3  EXECUTION

3.1  PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.
3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer’s written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

END OF SECTION
SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Thermoset-rubber base.
B. Resilient accessories.

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

PART 2 PRODUCTS

2.1 THERMOSET-RUBBER BASE (RB-1)
A. Basis of design: Johnsonite Mandalay
B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
   1. Style: Straight, rectangular shaped provide with a 45-degree chamfer top.
C. Thickness: 0.375 inch.
D. Height: 4-12 inches.
E. Lengths: Coils in manufacturer's standard length.
F. Colors: 40 Black.

2.2 VINYL MOLDING ACCESSORY
A. Description: Vinyl transition strips.
B. Profile and Dimensions: As indicated.
C. Locations: Provide vinyl molding accessories in areas indicated.
D. Colors and Patterns: Match rubber base.

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 manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
PART 3  EXECUTION

3.1  PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2  RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer’s recommended adhesive filler material.

G. Job-Formed Corners:
   1. Inside and Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Cope corners to minimize open joints.

3.3  RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4  CLEANING AND PROTECTION

A. Comply with manufacturer’s written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION
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.
B. Shop Drawings: For carpet tile installation, plans showing the following:
   1. Pattern of installation.
   2. Type, color, and location of edge, transition, and other accessory strips.
   3. Transition details to other flooring materials.
C. Samples: For each exposed product and for each color and texture required.

1.3  INFORMATIONAL SUBMITTALS
A. Product test reports.
B. Sample warranty.

1.4  CLOSEOUT SUBMITTALS
A. Maintenance data.

1.5  QUALITY ASSURANCE
A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.6  WARRANTY
A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2  PRODUCTS

2.1  CARPET TILE CPT-1 and CPT-2
A. Basis of Design: J+J Flooring Group
   CPT-1  Analog Mono 1822
   CPT-2  Strata Plank 1826
B. Substitutions: Under provisions of Section 01 25 13.
C. Color:  CPT-1: 1554 Associate
   CPT-2: 1851 Volcanic
D. Pattern: As indicated on drawings.

E. Wear Layer: Universal Fibers Polyester – Applied pattern.

F. Dye Method: Solution Dyed

G. Pile Thickness: .205 inches.

H. Total Weight: 40.5 – 46.8 oz./sq. yd. for finished carpet tile.

I. Primary Backing/Backcoating: Polyester Felt Cushion

J. Secondary Backing: Manufacturer's standard material.

K. Size: As indicated on drawings.

L. Applied Treatments:
   1. Soil-Resistance Treatment: Manufacturer's standard treatment
   2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
      a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

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 comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 EXECUTION

3.1 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

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. Concrete Substrates: 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 adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.
3.2 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer, install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots.

D. Install pattern indicated on Drawings.

E. 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.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. 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
SECTION 09 77 10
FABRIC-WRAPPED ACOUSTIC WALL PANEL

PART 1  GENERAL

1.1  WORK INCLUDED

A. Acoustic absorptive wall panel.
B. Acoustic diffusing wall panel.

1.2  RELATED WORK

A. Section 09 29 00 - Gypsum Board: Wall substrate.
B. Section 09 91 23 - Interior Painting: Priming of substrate surfaces.

1.3  REFERENCES

B. FS CCC-W-408 - Wall Covering, Vinyl Coated.
C. FS L-P-1040 - Plastic Sheets and Strips, Polyvinylflouride.

1.4  QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing acoustic wall panel with three years documented experience.
B. Applicator: Company specializing in installing wall panels with three years documented experience and approved by wall covering manufacturer.

1.5  REGULATORY REQUIREMENTS

A. Conform to applicable code for flame/fuel/smoke ratings of 25/35/50 when tested to ANSI/ASTM E84, NFPA 255, and UL 723.

1.6  SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 23.
B. Provide product data on wallcovering and installation requirements.
C. Submit samples under provisions of Sections 01 33 00 and 01 33 23.
D. Submit two samples of acoustic wall panel, 8 x 8 inch in size, illustrating color, finish, and texture.
E. Submit manufacturer's installation instructions under provisions of Sections 01 33 00 and 01 33 23.
F. Submit manufacturer's certificate under provisions of Section 01 78 39, and individual specification sections, that products meet or exceed specified requirements.

G. Submit test reports verifying flame/fuel/smoke ratings, when tested by UL and an agency approved by authority having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 66 00.

B. Store and protect products under provisions of Section 01 66 00.

C. Inspect roll materials on site to verify acceptance.

D. Protect packaged adhesive from temperature cycling and cold temperatures.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 60 degrees F, unless required otherwise by manufacturer's instructions.

B. Package and label each panel by destination room number, store where directed.

PART 2 PRODUCTS

2.1 MANUFACTURERS - ACOUSTIC ABSORBATIVE WALL PANELS

A. Basis of design: Kinetics Hardside High Impact Acoustical Panels

B. Wall Technology Inc.

C. Conwed.

D. Decoustics.

E. Lamvin, Inc.

F. Tectum.

G. Quiet Technology Systems.

H. Sound Seal.

I. MPC, Inc.


2.3 MATERIALS – ACOUSTIC ABSORBITIVE WALL PANELS


B. Core: 7 lb./c.f. fiberglass.

C. Vinyl Corners: Heat sealed, fully tailored.

D. Frame: Standard with manufacturer.
E. Mounting: Manufacturer’s standard clip system.
F. Dimensions: Thickness as required; width and heights per interior elevations.
G. NRC: 1.00

2.4 MANUFACTURERS – ACOUSTIC DIFFUSER WALL PANELS
A. Basis of design: RPG Acoustical Systems Golden Pyramid Panel.
B. Substitutions: Under provisions of Section 01 25 13.

2.5 MATERIALS – ACOUSTIC DIFFUSER WALL PANELS
A. Panel material: Reinforced Gypsum.
B. Size: 23 5/8” x 23 5/8” x 8 1/8”.
C. Finish: Painted
D. Mounting: Manufacturer’s standard clip system.

PART 3 EXECUTION

3.1 INSPECTION
A. Verify that substrate surfaces are painted and ready to receive work.
B. Beginning of installation means acceptance of existing surfaces and substrate.
C. Coordinate the placement of 20 ga. metal backing in the wall to support the installation of mounting clips.

3.2 INSTALLATION
A. Mount panels in accordance with manufacturer’s instructions.
B. Coordinate panel installation with the locations of any fire alarm system devices, motion detectors, exit signs or other electrical devices and with the location of any HVAC grilles in the areas shown to receive panels, to avoid interfering with the function of these items. Install panels fabricated as required to be clear of such devices where conflicts may exist.
C. Install termination trim.
D. Install continuous bead of clear caulking at all panel edges to wall, creating a continuous perimeter seal to wall.

3.3 CLEANING
A. Clean panels of dust, dirt, and other contaminants under provisions of Sections 00 74 13 and 00 74 23.
B. Touch-up minor finish imperfection per manufacturer’s recommendation.
C. Remove and replace work which cannot be successfully cleaned or repaired.
3.4 PROTECTION

A. Protect finished installation from any soiling or damage.

END OF SECTION
SECTION 09 91 23
INTERIOR PAINTING

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Surface preparation and the application of paint systems on the following interior substrates:
   1. Steel and iron.
   2. Gypsum board.

1.2  DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3  ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Acceptable Manufacturers:
   1. Sherwin Williams
   2. Dunn Edwards
   3. No substitutions allowed.

B. Products: Subject to compliance with requirements, provide one of the products listed above in the color listed in the Interior Painting Schedule for the paint category indicated.
2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated in the Finish Materials List in the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

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

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

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

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

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

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4  INTERIOR PAINTING SCHEDULE

A. Steel Substrates:
   1. Steel - Unprimed
      a. One coat 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
      b. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.
   2. Steel - Primed
      a. Touch-up with 100% acrylic rust inhibitive metal primer, 1.25 mils DFT.
      b. Two coats 100% acrylic enamel, semi-gloss, 3.5 mils DFT.

B. Gypsum Board Substrates:
   1. One coat 100% acrylic latex enamel primer, 1.2 mils DFT.
   2. Two coats 100% acrylic enamel, 2.8 mils DFT:
      a. Walls - eggshell.
      b. Soffits and ceilings - eggshell.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Furnishing all materials, labor, equipment, and related services necessary to supply and install recycled polyvinyl safety flooring as indicated in the contract documents, and in compliance with applicable codes.

1.2  RELATED SECTIONS

A. Section 03 30 53 – Miscellaneous Cast-in-Place Concrete: General building applications of concrete.

1.3  INFORMATIONAL SUBMITTALS

A. Product Data: Submit manufacturer’s product data and installation instructions for commercial kitchen applications.

B. Samples: Submit three (3) samples in the color reflected on the finish drawings.

C. Certification: Submit evidence of contractor qualifications as outlined under paragraph 1.5 – Quality Assurance. Provide letter from the manufacturer attesting to the installer certification.

D. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4  CLOSEOUT SUBMITTALS

A. Maintenance Data: Provide detailed maintenance instructions.

B. Warranties: Provide manufacturer and installation warranties as noted under paragraph 1.5 – Quality Assurance.

1.5  QUALITY ASSURANCE

A. Contractor will assure compliance with paragraph 1.6 – Project Conditions to allow for proper installation.

B. Comply with local governing codes and regulations.

C. Use factory trained installers that are certified and recommended by manufacturer, with 5 years’ experience installing this product.

1.6  PROJECT CONDITIONS

A. Comply with manufacturer’s written instructions for substrate temperature and humidity, ambient temperature and humidity, ventilation, and other conditions affecting the installation.

B. Environmental Limitations: Do not install flooring until building is enclosed and weatherproofed, wet work is complete, and the HVAC system or temporary heating maintains temperature and humidity at normal occupancy levels.
C. Acclimate flooring parts for a minimum of 24 hours to the ambient temperature and humidity levels of spaces in which they are to be installed.

D. Verify that concrete substrate conditions provide for slope to drains allowing water flow without assistance to drainage points. 1/4” per 1-foot average slope for radius’ to 4’ from drain center points are required.

E. Verify that floor drains are set ¼” above with finished concrete surface, and that floor waste/grease sinks and troughs are level and set 1/4” above the finished concrete surface to prevent floor drainage to those elements once the 1/4” floor is installed tight to these penetrations.

F. Slab substrates must be dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive.

G. Verify a clean, dry, and structurally sound surface to accept adhesive, free of cracks, ridges, depression, scales, and foreign deposits of any kind.

H. Verify that sub-floor concrete surfaces are ready for resilient flooring installation by testing moisture emission rate and alkalinity, in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

I. Do not begin installation of flooring until all project conditions have been met.

1.7 WARRANTY

A. Manufacturer must provide a limited 10-year product warranty against manufacturing defects.

B. Factory trained installer must provide a 1-year installation defect warranty.

PART 2 PRODUCTS

2.1 APPROVED PRODUCTS

A. Basis of Design: Eco-Grip Safety Flooring as manufactured by Allied Industries International, Inc.
   1. Eco-Grip Commercial Flooring. Sheets 5’ x 8’ in 1/4” thickness with color chosen by Architect as noted on plans.
   2. Eco-Grip Epoxy Flooring Adhesive.
   3. Eco-Grip V-Rod, welding rod or SpeedFlex Liquid Welding System.
   4. Eco-Grip Polyvinyl Cove Base Cap (high impact polyvinyl), Stainless Steel Base Cap, or Aluminum Base Cap.
   5. Stainless steel drain rings and transition strips, and #10 stainless screws and lead anchors as required.
   6. Eco-Grip sealants.
   7. Other installation materials as required and supplied by Eco-Grip.

B. Substitutions: Under provisions of Section 01 25 00.
2.2 SYSTEM STANDARDS

A. Eco-Grip Safety Flooring must meet the following test standards:
   1. ASTM G-21 - Bacteria & Mildew Resistance Excellent.
   2. ASTM D-751 - Breaking Strength (md) 405 lbs.
   3. ASTM D-751 - Breaking Strength (cmd) 723 lbs.
   4. ASTM D-2047 - Coefficient of Friction (avg) Dry 1.31.
   5. ASTM D-695 - Compressive Strength @ 20% Deformation 641 psi.
   6. ASTM D-751 - Elongation (md) 76.5%.
   7. ASTM D-751 - Elongation (cmd) 88.5%.
   8. ASTM E-648 - Critical Radiant Flux 1.05W/cm^2 – Type 1 NFPA fire classification.
   9. ASTM E-648 - Burn Distance 12 cm.
   10. Shore A hardness 85-90 avg.
   11. ASTM D-751 - Tear Strength (md) 76.5 lbs.
   12. ASTM D-751 - Tear Strength (cmd) 84 lbs.
   13. NFSI UWT-101A - Coefficient of Friction Standard >.06

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow manufacturer recommendations for laying sheets out. All welded joints must be offset with flooring sheets installed in an Ashlar fashion.

B. Flooring must be cut tight to all penetrations.

C. Adhere the floor material with 2-part epoxy mastic using the manufacturer’s recommended trowel notch size (3/32).

D. Seal cartridge adhesive/sealant should be used to seal base top and cap per the “Base Cap Detail” drawing, around all drains and sinks, and at all floor penetrations and transitions.

E. Roll floor into adhesive with 100 lb. roller immediately.

F. Install floor drains in accordance with drawing for “Stainless Collar Floor Drain Detail” drawings. Stainless steel drain rings are to be routed into floor surface and mounted flush with top of flooring. Secure drain rings using stainless steel fasteners and lead anchors that will properly anchor the ring to the substrate.

G. Install cove base as recommended by manufacturer with proper adhesive and top sealant.

H. Route out V-grooves between sheets and weld all seams using manufacturer’s 7mm V-shaped welding rod or manufacturer’s liquid weld system along with specified tools in accordance with manufacturer’s installation guidelines.

I. 16-gauge stainless steel transitions are to be installed at all doorways and transition areas. Use stainless steel fasteners, and lead anchors to secure.

J. All exposed edges are to be sealed with manufacturer’s recommended sealant to assure a watertight seal.

3.2 CLEANING

A. Sweep-clean the floor after installation and clear area of scrap materials. The floor can be saturated and then deck brushed, power washed, or power scrubbed (only use the 3M Green Cleaning Pad) to remove construction debris.
B. Installer must provide two (2) copies of manufacturer's cleaning recommendations for contractor and Owner use.

C. Protect in place from damage until final completion.

END OF SECTION
SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1  GENERAL

1.1  SECTION INCLUDES
   A. Section includes portable, hand-carried fire extinguishers with mounting brackets.

1.2  ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.3  INFORMATIONAL SUBMITTALS
   A. Warranty: Sample of special warranty.

1.4  CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.5  COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6  WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Six years from date of Substantial Completion.

PART 2  PRODUCTS

2.1  PERFORMANCE REQUIREMENTS
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

   B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2  PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
   A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
      1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

   B. Multipurpose Dry-Chemical Type: UL-rated 10 lb. nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard red enameled container.
C. Halotron I Type: UL-rated 10 lb. nominal capacity, with halocarbon-based clean fire extinguishing agent in manufacturer's standard red enameled container. Provide only at 1 location at laser cutting equipment.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with red baked-enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated on the drawings.
   1. Mounting Brackets: 48 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
SECTION 10 44 50
SPECIALTY SIGNS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Wall mounted raised character modified acrylic signs and frames.
B. Wall mounted cast aluminum lettering and logos.
C. Signage accessories.

1.2  RELATED SECTIONS

A. Section 09 21 16 – Gypsum Board Assemblies.

1.3  REFERENCES

A. ADAAG - Americans with Disabilities Act Accessibility Guidelines.

1.4  SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout spacing, reinforcement, accessories, and installation details.
C. Provide message list for each sign, including large-scale details of working, lettering, artwork and braille layout.
D. Samples for Verification: For each type of sign, include the following samples to verify color selected:
   1. Panel Signs: Full-size samples of each type of sign required.
   2. Approved samples will not be returned for installation into project.

1.5  DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products to site under provisions of Section 01 66 00.
B. Package signs, labeled in name groups.

1.6  REGULATORY REQUIREMENTS

A. Signage shall be designed in accordance with ANSI 117.1.
B. Comply with signage provisions of ADAAG.

1.7  WARRANTY

A. Provide a two (2) year warranty, in writing, warranting against manufacturing defects.
PART 2  PRODUCTS

2.1  MODIFIED ACRYLIC SIGNS

A. Manufacturer:
   1. Kroy Sign System, Inc.
   2. Product: Low Profile System.

B. Materials:
   1. Graphic Content and Style: Provide sign copy that complies with requirements indicated in UNLV Standards for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.
   2. ADA Accessibility Guidelines and ICC/ANSI A117.1 require tactile and braille characters to be raised a minimum of 1/32 inch from face of sign.
   3. Tactile and Braille Copy: Manufacturer’s standard process for producing copy complying with ADA Accessibility guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   5. Raised-Copy Thickness: Not less than 1/32 inch.
   6. Sizes: As shown on Drawings.

2.2  CAST LETTERS AND LOGOS:

A. Metal faced sides and returns, 1” depth, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
   1. Manufacturers:
      a. Gemini, Inc.
      b. A.R.K. Ramos
      c. Substitutions: Under provisions of Section 01 25 00
   2. Character Material: Aluminum, Brushed finish.
   3. Mounting: Manufacturer’s standard for size and design of character, and substrate.

PART 3  EXECUTION

3.1  EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means installer accepts existing surfaces.

C. Coordinate with work of other Sections interfacing with signage installation on which work could be detrimental to signage.

3.2  INSTALLATION

A. Install all signs plumb and level using double-backed tape and GE 2000 silicone adhesive in accordance with manufacturer’s instructions.

B. Install signs after surfaces are finished, in locations scheduled.

C. Locate sign on wall surface as indicated on Drawings.

D. Clean and polish.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Section includes wire mesh storage lockers.

1.2  ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Basis of design: Debourgh All American Team Locker

B. Substitutions in accordance with section 01 25 13.

2.2  MATERIALS

A. Steel Wire: ASTM A 510 (ASTM A 510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

E. Seismic Bracing: Angles with legs not less than 1-1/4 inch wide, formed from 0.040-inch-thick, metallic-coated steel sheet; with bolted connections and 1/4-inch-diameter bolts.

F. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

G. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.


2.3  WIRE MESH STORAGE LOCKERS

A. Unit Sizes:

1. Width: 12 inches.

2. Depth: 16 inches.

3. Height: 72 inches.
B. Mesh: 0.135-inch- diameter, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.

C. Wall Panels: 1-1/4-by-1-1/4-by-1/8-inch steel angle framing on top, bottom, and back sides, and 3-by-1/8-inch cold-rolled steel flat bar framing on front side, with wire mesh welded to framing.

D. Backs: 18 ga. thick, metallic-coated steel sheet. Required for back-to-back units only.

E. Doors: Fabricated from same mesh as wall panels, with framing fabricated from 1-1/4-by-1-1/4-by-1/8-inch steel angles on four sides with wire mesh welded to framing. Include padlock hasp.
   2. Hinges: Full-surface type, 2-1/2-by-2-1/2-inch steel, 1-1/2 pairs per single-tier door; bolted, riveted, or welded to door and jamb framing.
   3. Locks: provide cylinder locks for each opening. Provide 3 keys per opening and 3 master keys that open all lockers.

F. Base: 16 ga. thick, metallic-coated steel sheet, 6” high.

G. Finish for Uncoated Ferrous Steel: Enamel or powder-coated finish unless otherwise indicated.

H. Configuration: provide lockers in quantities and configurations of door openings as indicated on drawings.

2.4 FABRICATION

A. General: Fabricate wire mesh storage lockers from components of sizes not less than those indicated. Use larger size components as recommended by wire mesh manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer’s standard finishes.
   1. Fabricate wire mesh storage lockers to be readily disassembled.
   2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Wire Mesh Storage Lockers: Fabricate initial storage locker with front, back and two sides. Fabricate additional storage lockers as add-on units designed to share one side with initial storage locker.
   1. Fabricate wall panel and door framing with slotted holes for connecting adjacent panels.
   2. Pre-hang doors in factory.

2.5 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

C. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
D. Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel or powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.

PART 3 EXECUTION

3.1 WIRE MESH STORAGE LOCKERS ERECTION

A. Anchor wire mesh storage lockers to floor with 3/8-inch-diameter expansion anchors at 12 inches o.c. through bottom panel framing. Shim panel framing as required to achieve level and plumb installation.

B. Anchor wire mesh storage lockers to walls at 12 inches o.c. through back corner panel framing.

C. Attach adjacent wire mesh storage lockers to each other through side panel framing.

D. Install doors complete with door hardware.

3.2 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily without binding or warping. Adjust hardware to function smoothly. Confirm that hasps engage accurately and securely without forcing or binding.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION
SECTION 12 24 13
ROLLER WINDOW SHADES

PART 1    GENERAL

1.1   SECTION INCLUDES

A. Controlled motorized roller shade system for interior installation.
B. Manually operated roller shade system for interior installation.

1.2   RELATED SECTIONS

A. Section 09 22 16 - Non-Structural Metal Framing.
B. Section 09 29 00 - Gypsum Board.
C. Section 09 51 23 - Acoustical Tile Ceilings.
D. Section 26 00 00 - Basic Electrical Requirements.

1.3   REFERENCES

A. Abbreviations and Acronyms:
1. Nm: newton-meter, unit of torque.
2. VAC: alternating current voltage.
3. VDC: direct current voltage.
4. AV: audio-visual.
5. RF: radio frequency.

B. Definitions
1. Control: Effecting a change in state by one PC program onto a microprocessor or device.
2. Daylight Harvesting: The dimming of electric lighting sources when natural daylight is available.
3. Load Shedding: Intentional reduction of power consumption to avoid total power disruption due to overloading the circuits or reduction of power consumption to avoid crossing an agreed-on threshold of power usage. Load shedding lighting ballasts reduce the light level in response to a signal on the power line.
4. Monitor: Acquisition and presentation of status or operating condition of microprocessors or electrical devices in the network of the monitoring device or program.
5. Scene: Predetermined position of shades and light levels.
6. Scene Selection: Grouping of lighting and window shade controls into groups that will respond to a single scene command.
7. Shading Groups: Grouping rooms for common control of window shades.
1.4 ACTION SUBMITTALS

A. Shop Drawings - Indicate the following:
   1. Schematic diagram showing complete motorized shade system and integrated control equipment and accessories.

B. Window Treatment Schedule:
   1. List each roller shade, location, options, size, and special requirements.

1.5 QUALITY ASSURANCE

A. Source Requirements: Provide motorized roller shade system, lighting control system, and AV system with integrated control, automation, and monitoring capability from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver product in unopened factory packaging to predetermined location.

B. Store products in unopened factory packaging in a controlled environment:
   1. Ambient Temperature: 32 to 104 degrees Fahrenheit.
   2. Humidity: 0 to 85 percent.

1.7 SITE CONDITIONS

A. Environmental Conditions Range:
   1. Temperature: 32 – 104 degrees F (0 - 40 degrees C).
   2. Relative Humidity: 10 – 90 percent, noncondensing.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of motorized roller shades and control system that fail in materials or workmanship within the specified warranty period following substantial completion.

PART 2 PRODUCTS

2.1 ROLLER WINDOW SHADE SYSTEM

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, Inc., Rockleigh, NJ 07647, Phone (800)237-2041, Fax: (201)767-1903, www.crestron.com
   1. Substitutions under provisions of Section 01 25 13.

B. Description: Motorized roller window shade system (where indicated on drawings) shall be composed of the following integrated components:
   1. Motorized Roller Shades:
      a. Internal 24 VDC shade motor.
      b. Mounting brackets: CSS Décor 3
      c. Shade Fabric
   2. Shade Motor Power Supplies (existing system – coordinate with owner).
   3. Control Processors (existing system – coordinate with owner).
   4. Automation Control Sequences (existing system – coordinate with owner).
   5. Control User Interfaces (existing system – coordinate with owner).
C. Method of Control Communication:
   1. Wired Control.

D. Description: Manually Operated Window shade system (where indicated on drawings) shall be composed of the same components, shade fabric etc. as the Motorized system.

2.2 MOTORIZED ROLLER SHADES TYPE 1

A. Basis of Design Product: Crestron custom motorized roller shades.

B. Roller Shade shall be the following mounting type:
   1. Outside mount.

C. Motorized Roller Shade Motors: Motorized Roller Shade units shall be equipped with roller drive motors based on shade fabric weight and size and control and power requirements.

D. Shade Motor Type 1:
   2. Tubular, 24 VDC motor.
   5. Concealed within shade motor tube.
   6. Torque: 6 Nm.
   7. Provide wired real-time activity and status feedback to processor.
   8. Connections:
      a. Wired Control:
         1) System Connection: Provide power and control via multi-conductor Class 2 cable connected directly to power panel motor terminal.

2.3 SHADE FABRIC

A. Roller shades shall be the following fabric: Heritage (Room Darkening).

B. Fabric Color: Graphite (CSF-P7K07-00).

2.7 SYSTEM INTEGRATION

A. Shade system shall be connected to owner's existing processor and control system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation, examine work area to verify measurements, and that commencing installation complies with manufacturer's requirements.

3.2 INSTALLATION

A. Do not install roller shade or control devices until space is enclosed, HVAC systems are running, and overhead and wet work in roller shade work space are complete.
B. Install roller shades in accordance with manufacturer's instructions.

C. Connect to existing user interfaces in accordance with manufacturer's instructions.

D. Grounding: Provide electrical grounding in accordance with NFPA 70.

E. Perform setup for each roller shade component.

3.3 PRE-INSTALLATION MEETING

A. Installer of roller shade system to coordinate a meeting of the electrical contractor and owner’s representative. Include any designers and contractors for any other direct digital control system designed to interact with product of this Section.

1. Discuss interoperability of integrated systems and overall integrated system management and control.

3.4 OPERATING SOFTWARE INSTALLATION

A. Update program software as required to connect new shade to meet the Owner's requirements. Provide current system control and user interface programs and backup copies for the Owner's use.

3.5 SYSTEM STARTUP

A. Provide system startup and adjustment to occupied conditions in accordance with manufacturer's recommendations.

3.6 ADJUSTING

A. Within 2 months of the date of Substantial Completion provide onsite service to adjust the system to account for actual occupied conditions.

3.7 DEMONSTRATION

A. Schedule roller shade system demonstration with Owner to allow verification that shade system controls function as required.

B. Instruct owner's staff to adjust, operate and maintain roller shade system.

3.8 CLOSEOUT ACTIVITIES

A. Demonstration: Schedule roller shade system demonstration with Owner to allow verification that shade system controls function as required.

B. Instruct owner's staff to adjust, operate and maintain roller shade system.

C. Furnish set of approved submittals and record drawings of actual installation for Owner's personnel in attendance at training session.

END OF SECTION
SECTION 13 48 00
SOUND CONTROL ACCESS DOOR SYSTEMS

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Provide sound control door and frame assemblies where shown on the Drawings, as specified herein, and listed on the Door Schedule.

B.  The work includes door and frame assemblies complete with door lites, acoustical seals, cam-lift hinges, and all finish hardware factory supplied and installed. Door leaf and frame is factory assembled and shipped complete as one unit.

1.2  RELATED SECTIONS

A.  Section 08 71 00 - Door Hardware.

B.  Section 08 80 00 - Glazing.

C.  Section 09 22 16 - Non-Structural Metal Framing.

D.  Section 09 29 00 - Gypsum Board.

E.  Section 09 91 23 - Interior Painting.

1.3  SYSTEM PERFORMANCE REQUIREMENTS

A.  Sound Rating:  Provide door and frame assemblies that have been fabricated as sound-retardant units, tested according to ASTM E 90 and have the following certified Sound Transmission Class (STC) rating as determined according to ASTM E 413.
   1.  STC Rating 53
   2.  STC Rating 64

1.4  SUBMITTALS

A.  Comply with pertinent provisions of the Contract and Division 1.

B.  Product Data:  Within 30 calendar days after the Contractor has received the Owner’s Notice to Proceed, submit:
   1.  Material lists of items provided under this Section.
   2.  Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
   3.  Shop Drawings showing details of each frame type, elevations of door designs, details of openings, and details of construction, installation and anchorage.
   4.  Manufacturer’s recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
   5.  Test Reports from a qualified independent testing agency indicating and interpreting test results from Part 3 of this Section relative to compliance of sound ratings with the indicated requirements.
   6.  Material certificates in lieu of laboratory test reports when permitted by Architect signed by the manufacturer certifying that each sound control door complies with the project requirements,
   7.  Field test reports from qualified independent testing agency indicating and interpreting test results relative to compliance with performance requirements of installed sound control doors.
1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Acoustical Performance:
1. The acoustical door manufacturer will be required to submit acoustical performance data in the form of up-to-date test reports from an independent testing laboratory indicating the doors to be provided will have the required Sound Transmission Class Rating (ASTM E-90-90).
2. For the required STC rating, refer to door schedule drawing.
3. Owner may at his option order performance tests of installed door assemblies by an independent consultant to verify compliance with the specifications. Any discrepancies shall be repaired or replaced without cost to the Owner.

C. Single-Source Responsibility: Provide sound control doors and frames, including gaskets, hinges and other hardware items essential for sound control as an assembly and by a single firm specializing in producing this type of work for a minimum of ten (10) years.

1.6 DELIVERY, STORAGE AND HANDLING

A. Use all means necessary to protect the materials of this section before, during and after installation and to protect the installed work and materials of all other trades.

1.7 WARRANTY

A. Acoustic door materials and hardware shall be guaranteed against defective workmanship for one (1) year from date of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Single leaf, “Noise Lock” acoustic doors and frames with cam lift hinges and split frames as manufactured by IAC Acoustics, A Division of Sound Seal 401 Airport Road, North Aurora, IL 60542 630-270-1790.

B. Substitutions in accordance with Section 01 25 13.

2.2 MANUFACTURED ASSEMBLIES (NOISE LOCK DOORS)

A. Door leaf(s) minimum thickness:

   STC 53 Rating, 2-1/2”
   STC 64 Rating, 5”

   Door leaf(s) and door stiffeners are to be fabricated from 14 gauge (2 mm) cold rolled, galvannealed steel with an A60 coating weight, and filled with 6 lb density, sound absorbing, and damping elements.

B. Frame(s) shall be fabricated from 14 gauge cold rolled, galvannealed steel with an A60 coating weight and furnished “split” in two (2) pieces, inside and outside, that are mitered and welded together allowing for easy installation into either existing or new construction openings.
C. Acoustic seals: Doorjambs, meeting stiles of double doors and at the head of the door and frame shall receive self-aligning magnetic, [fire resistant (if UL rated)] compression seals. Door(s) to be held in closed position by magnetic force of perimeter seals. Acoustic labyrinth shall be created when door is in closed position. Bottom of door leaf shall contain continuous, adjustable, gravity-activated seal that shall compress against the floor as the door is closed. Raised sills and threshold drop seals will not be acceptable.

Acoustic Seal assemblies as follows:
STC 53 Rating, Double magnetic type
STC 64 Rating, Magnetic tri-seal type

D. Jamb anchors: Provide jamb anchors as determined by wall construction. Anchors are to be spaced at 12” (305 mm) on center (max) and are to be of a corrosion resistant material.

E. Hardware:
1. Hinges: IAC, cam-lift, butt-type, hinges, US26D finish (Hinge manufacturer to furnish laboratory test data certifying that hinges of identical design have been cycled a minimum of 125,000 times while supporting a door leaf weighing a minimum of 350 lbs.).
   a. Quantities of hinges as follows:
      1) For door leaf thickness less than or equal to 2-1/2” (64):
         Two (2) hinges required per leaf for openings up to and including 96” high.
         Three (3) hinges required per leaf for openings up to and including 120 high
      2) For door leaf thickness greater than 2-1/2” (64):
         Three (3) hinges required per leaf for openings up to and including 96” high.
         Four (4) hinges required per leaf for openings up to and including 120” high.
   
2. Closers: LCN, factory installed.
3. Latchsets/Locksets: Provided and installed by door manufacturer. Refer to finish hardware section for manufacturer, type and details.
4. Electric Strikes: Provided and installed by door manufacturer. Refer to finish hardware section for manufacturer, type and details.

F. Hardware Reinforcement:
1. Hinges: Minimum of 1/4” thick x 2” wide x 7-1/2” lg.
2. Frames: Minimum of 3/16” thick for strikes and #11 gauge for closers.
3. Doors: Minimum of #11 gauge for lock boxes and closers.

G. Fire Rating: Those openings scheduled, as fire rated, shall have been tested by and bear the labels of Underwriters Laboratories marked for:

H. Glazing:
1. Non-Fire Rated: Provide factory-installed, aluminum extruded stops and moldings with true mitered corners for double, glazed assemblies. Size of vision lite is to be determined from the door schedule. Safety glass or fire-resistive glazing product meeting doors’ sound control and labeling requirements is acceptable.
2.3 PRE-HUNG

A. Assembly and adjustment of door leaf, frame, acoustic seals, hinges and associated finish hardware shall take place at the factory to insure ease of installation, reliable operation and acoustic performance. The entire manufactured assembly shall be shipped to the job site ready to install and operate.

2.4 FABRICATION

A. General: Fabricate units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Wherever practical, fit and assemble units in the manufacturer’s plant. Identify work that is not permanently factory-assembled before shipment to ensure proper assembly at the Project site. Weld exposed joints continuously: grind, fill dress and make smooth flush and invisible.

2.5 FINISHES (FACTORY)

A. Doors and frames shall receive a shop coat of a rust-inhibitive primer. The primer shall be applied over properly prepared metal, in accordance with the manufacturer’s standard shop prime coat procedure and oven-baked dry.

B. Others, as required, will perform finish painting, staining and/or varnish, under the painting section 0990 of this Specification.

C. AWI premium grade maple, rotary cut with book matched grain, paper-backed, wood veneer shall be applied as a finish, on both sides of the doors.

PART 3 EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

A. Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog installation instructions and product carton instructions.

3.2 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

B. Adjacent Construction: Coordinate door assembly details with details of adjacent work to ensure proper attachments and clean junctions.

3.3 INSTALLATION

A. Install work in accordance with reviewed shop drawings and these specifications using only factory-trained personnel as required by the Manufacturer and approved by the Architect.

1. Hang doors and adjust for free swinging operation without binding, sticking, sagging or excessive clearances.

2. During installation, solidly pack acoustic insulation around frames that are installed in stud and gypsum-wallboard partitions.

3. Caulk exterior joint prior to painting.

4. Install sound control door assemblies during finish phase of construction to protect units from damage.

5. When installation is otherwise complete, adjust operating hardware for proper operation and function.
3.4 FIELD QUALITY CONTROL

A. Upon completion of this portion of work, and prior to its acceptance by the Owner, secure a visit to the job site by a qualified representative of the manufacturer of the acoustical door system(s) to confirm that installation is in conformance with the manufacturer’s recommendations.

3.5 FIELD TESTING

A. Testing Agency: Provide the service of an independent testing agency experienced in testing sound control doors and is acceptable to architect to perform sound control field-testing.

B. Selection: Test all installed sound doors.

C. Testing Requirements: Conduct field tests according to ASTM E336 with results calculated according to ASTM E413 to confirm that the operating field NIC values are within 5 dB of laboratory STC values.

D. Test results shall be reported promptly and in writing by testing agency to Owner, Contractor and Architect.

E. Repair or replace components of sound control doors where test results indicate STC rating does not meet requirements.

3.6 DEMONSTRATION

A. Instruct the Owner’s maintenance personnel regarding operation and maintenance of all acoustic doors.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures.

F. "Provide" and "Install" means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.
1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

1.6 REGULATORY REQUIREMENTS

A. Requirements of Regulatory Agencies:
   1. Welding Qualifications.
   2. ASHRAE.
   3. UL Publications.
   4. ASTM.
   5. TEMA.
   6. OSHA.
   7. EPA.
   8. ARI.
   9. NFPA.
   10. UMC.
   11. UPC.
   12. IBC

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 "Access Doors and Frames."
PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

B. Architect may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.

C. Repair and refinish work damaged by the Work of this Division, to Architect's satisfaction. Obtain finishing materials from equipment manufacturer.

2.2 MANUFACTURERS (All pipe and accessories shall be manufactured in the U.S.A.).

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.3 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.5 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
   2. Underground Piping NPS 1-1/2 inches and Smaller: Manufactured fitting or coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent cement-joint end.
   1. Manufacturers:
      a. Eslon Thermoplastics.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Eclipse, Inc.
      c. Epco Sales, Inc.
      e. Watts Industries, Inc.; Water Products Div.
      f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Thunderline.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.9 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

A. General: Excavation and backfill, if required to install the Work specified in this Division shall be performed in compliance with the following requirements.

B. Excavation: Bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until final inspection and approval for the piping installation by the Inspection Services.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
      g. Bare Piping in Unfinished Service Spaces: One-piece stamped-steel type with concealed hinge and set screw or spring clips.
      h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Thermal and Moisture Protection" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

H. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   1. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.
   5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment.
   2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 MECHANICAL INSTALLATIONS

A. The requirements of this Section apply to all the Work of Division.

B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the Architect for his decision. The decision of the Architect is final.

C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations
necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.

D. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.

E. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

3.7 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections “Interior Painting” and “Exterior Painting.”

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section “Metal Fabrications” for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Bronze swing check valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:
   1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES (valves shall be manufactured in the USA)

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:
   1. Solder Joint: With sockets according to ASME B16.18.
   2. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Apollo Valve Company.
      f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Bronze.
      i. Ball: Stainless Steel
      j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Stockham Division.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Two piece, full port, bronze with stainless steel, Ball.
   3. Bronze Swing Check Valves: Class 150, bronze disc.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.

B. Related Sections include the following:

C. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

D. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting. Combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
3. Pipe positioning systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   2. Carpenter & Paterson, Inc.
   3. Grinnell Corp.
   5. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
   2. Thomas & Betts Corporation.
   3. Tolco Inc.
   4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. Pipe Shields, Inc.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Manufacturers:
2. Hilti, Inc.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

G. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

H. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

I. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

J. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricated from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
   3. Hang pipe from primary building structure. Piping shall not be hung from other piping. All rigid hangers shall provide a means for vertical adjustment after erection.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Restrained elastomeric isolation mounts.
   4. Housed spring mounts.
   5. Elastomeric hangers.
   7. Pipe riser resilient supports.
   8. Resilient pipe guides.
  10. Restraining braces and cables.

1.3 DEFINITIONS


1.4 PERFORMANCE REQUIREMENTS

1. Seismic-Restraint Loading:
2. Site Class as Defined in the IBC: Refer to Structural.
3. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to Structural.
   a. Component Importance Factor: Refer to Structural.
   b. Component Response Modification Factor: Refer to Structural.
   c. Component Amplification Factor: Refer to Structural.
4. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to Structural.
5. Design Spectral Response Acceleration at 1-Second Period: Refer to Structural.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Nevada responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators seismic restraints, and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads power transmission, component misalignment, and cantilever loads.

4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproved by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred.
Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Amber/Booth Company, Inc.
   3. Mason Industries.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
   1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
   2. Base: Factory drilled for bolting to structure.
   3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

G. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and Support spring coil.

H. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of
   1. Steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

I. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Amber/Booth Company, Inc.
   3. Mason Industries.
   4. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of Neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
   1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators.
2. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

3. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).

4. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer’s recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to stressed component (unless post connection testing has been approved), and with at least seven days' advance notice.


4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.


7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Pads:
   b. Thickness: Refer to drawings.
   c. Number of Pads: Refer to drawings.
SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Stencils.
   5. Valve tags.
   6. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger
lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.


B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.
   2. Provide framed/laminated valve chart(s) at wall near equipment.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.
3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Provide red ceiling tacks ¾” Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      c. Natural Gas: 1-1/2 inches, round.
   2. Valve-Tag Color:
      b. Hot Water: Natural.
      c. Natural Gas: Natural.
   3. Letter Color:
      b. Hot Water: Black.
      c. Natural Gas: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Cellular glass.
      b. Mineral fiber.
      c. Polyisocyanurate.
   2. Insulating cements.
   3. Adhesives.
   5. Lagging adhesives.
   7. Factory-applied jackets.
   8. Field-applied jackets.
   10. Securements.
   11. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application at linkages of control devices.
   7. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.
1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Store insulation in original wrapping and protect from weather and construction damage.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cell-U-Foam Corporation; Ultra-CUF.
      b. Pittsburgh Corning Corporation; Foam glass Super K.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000(Pipe Insulation.
      c. Manson Insulation Inc.; Alley-K.
      d. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   3. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   4. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; CrimpWrap.
      b. Johns Manville; MicroFlex.
      c. Knauf Insulation; Pipe and Tank Insulation.
      d. Manson Insulation Inc.; AK Flex.
J. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Dow Chemical Company (The); Trymer.
      c. Duna USA Inc.; Corafoam.
      d. Hi Therm
   2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
   3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
   4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
      a. Pipe Applications: ASJ.

2.2 INSULATING CEMENTS

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Insulco, Division of MFS, Inc.; Triple I.
   2. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
      1. Products: Subject to compliance with requirements, provide one of the following:
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Insulco, Division of MFS, Inc.; SmoothKote.
         c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-96.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-52.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.

3. Service Temperature Range: Minus 50 to plus 180 deg F.


2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Pittsburgh Corning Corporation; Pittseal 444.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.


2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136,
3. Type I.
4. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC Jacket for Outdoor Applications: 6-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      a. Factory cut and rolled to size.
      b. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      b. Compac Corp.; 110 and 111.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
      d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
      b. Compac Corp.; 130.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
      d. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

M. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even application. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

B. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints at ends adjacent to pipe flanges and fittings.

D. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

E. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

F. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

G. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation.

B. For applications requiring only outdoor insulation, install insulation to the bottom of the roof penetration and seal the gap with joint sealant.
insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Thermal and Moisture Protection" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Thermal and Moisture Protection".

3.5 EQUIPMENT INSULATION INSTALLATION

A. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe
insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

C. Install pipe insulation to outer diameter of pipe flange.

D. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

E. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

F. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

G. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

H. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o’clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer’s written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of polyisocyanurate insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer’s recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer’s recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor’s option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot and Tempered Water:
   1. Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I:

**TABLE 22 07 00-A**
PIPE INSULATION SCHEDULE
INSULATION THICKNESS FOR NOMINAL PIPE SIZES

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>RANGE</th>
<th>TEMP. 1 AND</th>
<th>TEMP. 1-1/4</th>
<th>TEMP. 2-1/2</th>
<th>TEMP. 6 AND UP</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LESS</td>
<td>TO 2</td>
<td>TO 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td>90-200</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td>--</td>
<td>All Service</td>
</tr>
<tr>
<td>Hot/Tempered Water Return Domestic</td>
<td>90-200</td>
<td>1.0</td>
<td>1.0</td>
<td>--</td>
<td>--</td>
<td>All Service</td>
</tr>
<tr>
<td>Cold Water Domestic</td>
<td>Any</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td>--</td>
<td>All Service</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather shall be provided with aluminum covering.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. PVC 30 mils thick.

**TABLE 22 07 00-B**
VALVE AND FITTING JACKET SCHEDULE

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LOCATION</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td>All Concealed</td>
<td>Glass Cloth And Adhesive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Or Premolded</td>
</tr>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td>All Exposed</td>
<td>Premolded Cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interior Only</td>
</tr>
<tr>
<td>Cold Water Domestic</td>
<td>All Exposed</td>
<td>Premolded Cover</td>
</tr>
<tr>
<td>Non-Conditioned Areas</td>
<td></td>
<td>Interior Only</td>
</tr>
<tr>
<td>All Exterior Piping Jacket</td>
<td>All Exposed</td>
<td>Rigid Insulation with Full Metal</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
   2. Encasement for piping.
   4. Flexible connectors.
   5. Water meters.
   7. Sleeves and sleeve seals.
   8. Wall penetration systems.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to the IBC.

1.4 SUBMITTALS

A. Product Data: For the following products:
   1. Specialty valves.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Flexible connectors.
   5. Water meters.
   7. Escutcheons.
   8. Sleeves and sleeve seals.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.
1.7 DELIVERY STORAGE AND PROTECTION

A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.

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.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS (all pipe and fitting shall be manufactured in the U.S.A.)

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
   2. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.
         3) Viega: Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.

C. Material: LLDPE film of 0.008-inch minimum thickness.

D. Color: Black or Natural.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      c. Zurn Plumbing Products Group; Wilkins Water Control Products.
   2. Description:
      a. Pressure Rating: 150 psig at 180 deg F.
      b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Factory-fabricated, bolted, companion-flange assembly.
   b. Pressure Rating: 150 psig (1035 kPa), 175 psig (1200 kPa) minimum, 300 psig (2070 kPa) as required for the project.
   c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexicraft Industries.
   2. Hyspan Precision Products, Inc.
   3. Metraflex, Inc.
   4. Proco Products, Inc.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig, 250 psig as required.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.9 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.


D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

E. One-Piece Floor Plates: Cast-iron flange.

F. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.10 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.  
   1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

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

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.  
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers. (Unless otherwise specified on drawing)

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to manufacturer's written requirements.
I. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping adjacent to equipment and specialties to allow service and maintenance.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages. (Unless otherwise specified on drawings).

T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

E. Locate valves for easy access and operation; where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.

F. Do not locate valves with stems below horizontal.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. NPS and Larger: Sleeve-type coupling.
   3. Dissimilar pipes (Copper to PVC): Make transition from PVC to copper at five feet outside the building (or beyond the concrete sidewalk) with schedule 80 T.O.E. Nipples for pipes 2" and smaller, and with PVC to copper flange with brass bolts and nuts for 2 ½" and larger. Wrap joints with "Ten Mil" Polyethylene tape and jacket per ANSI/AWWA C105.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipeolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.
C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
   5. Bare Piping in Equipment Rooms: One piece, cast brass
   6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
3.10 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls. (wrap un-insulated copper pipe through ferrous sleeves or in contact with concrete with protective tape)

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 "Thermal and Moisture Protection" for joint sealants.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 "Thermal and Moisture Protection" for joint sealants.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:
   1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
   2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
      a. Extend sleeves 2 inches above finished floor level.
      b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 "Thermal and Moisture Protection" for flashing.
   3. Sleeves for Piping Passing through Gypsum-Board Partitions:
      a. Steel pipe sleeves for pipes smaller than NPS 6.
      b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
      c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
   4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
   5. Sleeves for Piping Passing through Exterior Concrete Walls:
      a. Steel pipe sleeves for pipes smaller than NPS 6.
      b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
      c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
   6. Sleeves for Piping Passing through Interior Concrete Walls:
      a. Steel pipe sleeves for pipes smaller than NPS 6.
      b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply
with requirements in Division 07 "Thermal and Moisture Protection" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.13 TEST/FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   5. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.
F. The following tests shall be made in the presence of the Inspection Services and the Architect. Forty-eight (48) hours notification shall be made prior to tests.

G. Potable Water and Industrial Water Piping Leakage Test:
1. General: After completion of the Work, but before final, acceptance is made, run a test over a four hour period of time to prove that the capacity and performance of all apparatus fittings and the system as a whole meets the requirements of the specifications.
3. Cold and hot water services within the Building shall be tested at 120 psi for a period of 4 hours. Any joints showing visible leakage shall be cut out and remade; opening of joints shall not be permitted. Retest sections of pipework containing remade joints.
4. All underground water piping shall be tested to 150 psi pressure for three (3) hours. After tests, water pressure shall be left under supply main pressure for the balance of the construction period.

3.14 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 CLEANING

A. Clean and disinfect potable service entrance piping and water distribution piping as follows:
1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for 3 hours.
   c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.
B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

D. The contractor is required to perform the flushing and disinfection of the cold and tempered water loops in every phase of work.

E. During each phase of construction when the water supply system is open for remodel the contractor must flush and disinfect the system per Specification 221116, Paragraph 3.16 at the end of work in that phase.

F. Clean non-potable domestic water piping as follows:
   1. Purge new piping before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

G. Prepare and submit reports of purging and disinfecting activities.

H. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints. As required by local codes.

E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L wrought-copper solder-joint fittings; and soldered joints.

F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L wrought-copper solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 5 to NPS 8 shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L wrought-copper solder-joint fittings; and soldered joints.

3.17 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball valves for piping NPS 2 1/2 and smaller. Use butterfly, ball valves with flanged ends for piping NPS 3".
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION
SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Vacuum breakers.
   2. Balancing valves.
   3. Air vents.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless
   otherwise indicated.

1.4 SUBMITTALS

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

B. Operation and Maintenance Data: For domestic water piping specialties to include
   in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
   NFPA 70, Article 100, by a testing agency acceptable to authorities having
   jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by
      one of the following:
      a. Cash Acme.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      e. Zum Plumbing Products Group; Wilkins Div.
   3. Size: NPS 1/4 to NPS 3 as required to match connected piping.
   5. Inlet and Outlet Connections: Threaded.

B. Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by
      one of the following:
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.2 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. ITT Industries; Bell & Gossett Div.
      c. NIBCO INC.
      d. Taco, Inc.
      e. Watts Industries, Inc.; Water Products Div.
   2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
   3. Body: bronze,
   4. Size: Same as connected piping, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.3 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hoffman No. 79
      b. Bell & Gossett
      c. Or equal
   2. Body: Bronze.
   7. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hoffman No. 79
      b. Bell & Gossett
      c. Or equal
   7. Inlet and Vent Outlet End Connections: Threaded.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install air vents at high points of water piping. (Unless otherwise specified on drawing)

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Reduced-pressure-principle backflow preventers.
   5. Primary, thermostatic, water mixing valves.
   6. Primary water tempering valves.
   7. Supply-type, trap-seal primer valves.
   8. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION
SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. NBR: Acrylonitrile-butadiene rubber.
D. PE: Polyethylene plastic.
E. PVC: Polyvinyl chloride plastic.
F. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to IBC.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
   1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping. PVC DWV pipe must be solid wall, not cellular core.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. (all pipe and fittings shall be manufactured in the U.S.A.)

2.2 PIPING MATERIALS

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

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Standard, Shielded, Heavy Duty, Type 304 Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
      a. Manufacturers:
         1) ANACO.
         2) Fernco, Inc.
         3) Ideal Div.; Stant Corp.
         4) Mission Rubber Co.
         5) Tyler Pipe; Soil Pipe Div.

2.4 PVC SCHEDULE 40 SOLID WALL PIPE AND DWV FITTING SYSTEM

A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Fittings shall conform to ASTM D 2665.

B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer’s recommendations and local code requirements. Testing with compressed air or gas may result in injury or death. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656. The system to be manufactured by Charlotte Pipe and Foundry Co. and is intended for non-pressure drainage applications where the temperature will not exceed 140 degrees F.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.
3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste piping and vent piping shall be the following:
1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
2. 1-1/4- and 1-1/2-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
3. 2- to 4-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
4. 2- to 4-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
5. 5- and 6-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
6. 5- and 6-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
7. 5- and 6-Inch NPS: Hard copper drainage tube; copper, grooved-end fittings; and copper, keyed couplings.

C. Underground, soil, waste, and vent piping shall be the following:
1. 1-1/2-Inch NPS: Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
2. 1-1/2- Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NFC) standard 14.
3. 2- to 4-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
4. 2-to4- Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14.
5. 2- to 4-Inch NPS: PVC plastic pipe, solid wall only. Foam or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints.
6. 5-and 6-Inch NPS: PVC plastic pipe, solid wall only. Foam core or cellular core is not acceptable, PVC socket fittings, and solvent-cemented joints. Pipe and fitting shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with national Sanitation Foundation (NSF) standard 14.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to UPC/IAPMO standards.

M. Install underground PVC soil and waste drainage piping according to UPC/IAPMO standards.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main or sanitary manhole.
   2. Sewage Pumps: To sewage pump discharge.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and un concealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.
3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.
PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Threaded.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.
14. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall installation frame and cover

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. ProSet Systems Inc.
4. Size: Same as connected soil, waste, or vent stack.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
7. Special Coating: Corrosion resistant on interior of fittings.
8. MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

B. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
1. Description: Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.3 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Related Sections include the following:
   1. Division 10 Section "Specialties."
   2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.


1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   5. Hose-Connection Vacuum Breakers: ASSE 1011.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   2. Brass and Copper Supplies: ASME A112.18.1.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Disposers: ASSE 1008 and UL 430.
   6. Off-Floor Fixture Supports: ASME A112.6.1M.
1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures of unit shell.
      b. Faulty operation of controls, blowers, pumps, heaters, and timers.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fixtures: Acorn, American Standard, Kohler, Haws, Elkay or Just.

B. Supplies
   1. American Standard
   2. Kohler

C. Stops
   1. American Standard
   2. Kohler

D. Traps
   1. American Standard
   2. Kohler
   3. Crane

E. Fixture Supports
   1. Zurn
   2. J.R. Smith
   3. Wade

F. Drains
   1. J.R. Smith
   2. Josam
   3. Zurn
   4. or equal.

2.2 MATERIALS

A. Plumbing Fixtures Schedule

2.3 FIXTURES AND TRIM

A. See drawings for fixture types and specifications.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. The stop shall be a loose key stop.
   1. Exception: Use ball or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
N. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.

O. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Replace washers and seals of leaking and dripping faucets and stops.

C. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION
SECTION 23 05 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Equipment installation requirements common to equipment sections.
   8. Painting and finishing.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

H. Provide” and “Install” means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

#
1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

1.6 REGULATORY REQUIREMENTS

A. Requirements of Regulatory Agencies:
   1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Welding Qualifications.
   2. ASHRAE.
   3. UL Publications.
   4. ASTM.
   5. ANSI B31.1, "Code for Pressure Piping".
   6. TEMA.
   7. OSHA.
   8. EPA.
   9. ARI.
   10. NFPA.
   11. UMC.
   12. UPC.
   13. IBC

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

B. P.M. may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.

C. Repair and refinish work damaged by the Work of this Division, to P.M.'s satisfaction. Obtain finishing materials from equipment manufacturer.

2.2 MANUFACTURERS (ALL PIPE AND ACCESSORIES SHALL BE U.S.A. MANUFACTURED).

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.3 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.4 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
   2. Capitol Manufacturing Co.
   3. Central Plastics Company.
   4. Eclipse, Inc.
   5. Epco Sales, Inc.

D. Dielectric Nipples:

E. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Thunderline.
      b. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
      c. Pressure Plates: Stainless steel. Include two for each sealing element.
      d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

L. Sleeves are not required for core-drilled holes.
M. Permanent sleeves are not required for holes formed by removable PE sleeves.
N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   4. PVC Pipe Sleeves: For pipes smaller than NPS 6.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.
S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA’s “Copper Tube Handbook,” using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” “Pipe and Tube” Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 MECHANICAL INSTALLATIONS

A. The requirements of this Section apply to all the Work of Division.

B. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the P.M. for his decision. The decision of the P.M. is final.

C. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.

D. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.

E. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.
3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION
SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 2,160 ft above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficiency, as defined in NEMA MG 1.

C. Service Factor: 1.15.
Multispeed Motors: Variable torque.
1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

Multispeed Motors: Separate winding for each speed.

Rotor: Random-wound, squirrel cage.

Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

Temperature Rise: Match insulation rating.

Insulation: Class F.

Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

### 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 COUPLINGS

2.6.1 Couplings for direct drive equipment shall be flexible, self-aligning, non-lubricating type, rated at least 125% of motor rated horsepower.

2.6.2 Coupling halves shall be keyed and locked on shafts.

2.6.3 Manufacturer: Couplings shall be Fast's Standard, or John E. Lisee Pump, Inc.

2.7 BELT DRIVES

2.7.1 General

1. Belt drives shall be V-belt type with appropriate sheaves.
2. Minimum of two belts per drive.
3. Motors 15 HP and smaller shall be provided with variable pitch sheaves and installed on motor slide rails.
4. Motors 20 HP and larger shall have non-adjustable drive sheave and be installed on motor slide rails.
5. After air balance is completed and air balance has been accepted by the Engineer/ P.M., change each variable pitch sheave to fixed pitch sheave.
6. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.

2.7.2 Sheaves

1. Sheaves shall be cast iron, machined and balanced.
2. Variable pitch sheaves shall be selected for mid-point of equipment operating capacity.
3. Sheaves shall be keyed and located on shafts, with Allen head set screws. On fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.

2.7.3 Ratings

1. Belt drives for one and two cylinder reciprocating compressors: Minimum horsepower rating, at design speed, of 1.7 times the motor nameplate horsepower rating.
2. All other belt drives: On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belt or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

2.8 GUARDS

2.8.1 General: All rotating elements on equipment shall have protective devices in accordance with the CCR Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.

2.8.2 Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel in accordance with OSHA requirements.

2.8.3 Belt Guards

1. Guards shall totally enclose the belts and sheaves. Guards shall be fabricated of galvanized expanded metal sides, solid galvanized steel band and adequately sized galvanized angle iron frame.
2. Adequate room for belt adjustments shall be provided.
3. Tachometer holes with covers shall be provided for both sheaves.
PART 3 - EXECUTION (Not Applicable)

END OF SECTION
SECTION 23 05 29
HANGERS AND SUPPORTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Equipment supports.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
   3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

B. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. ASME Boiler and Pressure Vessel Code: Section IX.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. Thermo Hanger Sheild, Inc.
   2. Portable Pipe,
   3. Hanger, Inc.
   4. Channel Support Systems
   5. Miro Industries

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 THERMAL-HANGER SHEILD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
   1. PHS Industries, Inc.
   2. Pipe Shields, Inc.
   4. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar joist construction to attach to top flange of structural shape.
   2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

I. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

I. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   4. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

#
SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Restrained elastomeric isolation mounts.
   4. Housed spring mounts.
   5. Elastomeric hangers.
   7. Spring hangers with vertical-limit stops.
   8. Seismic snubbers.
   9. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS


1.4 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment where indicated on the drawings.

B. Provide minimum static deflection of isolators for equipment as indicated on the drawings.

C. Seismic-Restraint Loading:
   1. As defined in the IBC.
   2. As specified by Structural documents for this project.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including
analysis data signed and sealed by the qualified professional engineer licensed in the State of Nevada responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
   d. Pre-approval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

F. Manufacturer's field reports.

G. Project Record Documents: Record actual locations of hangers including attachment points.

1.6 QUALITY CONTROL

A. Comply with seismic-restraint requirements in the IBC.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage pre-approval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred.
Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amber/Booth Company, Inc.
   2. I.S.A.T (International Seismic Application Technology).
   5. M.W. Sausse/Vibrex

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: Not less than 80 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
   1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
   2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amber/Booth Company, Inc.
   3. Mason Industries.
   4. M.W. Sausse

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amber/Booth Company, Inc.
   2. Hilti, Inc.
   5. TOLCO Incorporated; a brand of NIBCO INC.
   6. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

A. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 7 Section “Roof Accessories” for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:
1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Demonstration and Training."

3.7 OWNER'S FIELD VERIFICATION

A. Provide services of testing agency to take noise measurement per Owner's request for two (2) eight (8) hour days (non-concurrent) as scheduled with Owner's designated representative. Use meters meeting requirements of ASA 47 (ANSI S1.4).

END OF SECTION
SECTION 23 05 53
IDENTIFICATION FOR HVAC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.
   5. Stencils.
   6. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 Manufacture

A. Manufacturers:
   1. Brady Corporation,
   2. Brimar Industries, Inc
   3. Marking Services, Inc (MSI)
   4. Panduit Corporation,
   5. Seton Identification Products

2.2 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate

engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


4. Maximum Temperature: Able to withstand temperatures up to 160 degF.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate
2. Flow Direction: At least 1-1/2 inches high.

2.5 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Yellow.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.6 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
   1. Identification Paint: Use for contrasting background.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.

D. Provide red ceiling tacks ¾” Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

E. Room temperature sensors shall have engraved nameplates on wall adjacent to temperature sensor that identify the room number, zone number and the HVAC unit number that serves that room.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum...
intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

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

B. Testing, Adjusting, and Balancing HVAC systems shall be performed by a specialized firm.

C. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including sub mains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   5. Reporting results of the activities and procedures specified in this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 1 – Quality Control
B. Division 1 – Testing Laboratory/Agency Services
C. Division 1 – Starting of Systems
D. Division 1 – System Demonstration
E. Division 1 – Testing, Adjusting, and Balancing
F. Individual Sections: Qualification of testing organization; specific services required. Where there is any conflict of services or directions between Sections regarding the Testing and Balancing of Systems, contact the Architect immediately.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high Air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a Closed system, static head is equal on both sides of the pump.

E. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

G. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

H. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

I. Test: A procedure to determine quantitative performance of a system or equipment.

J. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.


M. CTI: Cooling Tower Institute.

N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Refer to Div. 1 – Submittal Procedures, for submittal requirements.

B. Draft Reports: prior to commencing work, submit a detailed agenda of balancing procedures for this project. Include a draft report utilizing proper and relevant report forms appropriate to the procedures. The forms shall be essentially completed with design criteria and approved performance data of the equipment approved for use. This shall be representative of the information to be included in the final report. Accompanying this agenda/draft report shall be a complete set of approved performance submittal data on equipment relevant to the HVAC systems, etc. Also, submit the AABC National Project Performance Guarantee, or the acceptable equivalent thereof.

C. Test Reports: Prior to the final acceptance of the project, submit for approval and for inclusion into the operating and maintenance manuals. Provide the report in six copies, letter size, spiral-type (3-ring for larger reports) permanent binder, with index page, tabs, with cover identification. The report shall also include a significant General Comments section identifying unusual or incomplete final conditions that could not be remedied fully or satisfactorily. This shall also summarize such significant data that may appear on individual test data sheets. Included in the report shall be reduced scale drawings with air outlets and equipment identified to correspond to the data sheets but also the final as-built, contract drawings with respect to mark numbers, room numbers and other significant physical I.D., etc. Also show final locations of thermostats, sensing elements and duct traverses. The report shall provide evidence that all reasonable efforts on the part of the TABA and the related trades shall have been performed sufficiently to remedy any remaining deficiencies. The report shall include an appendix with copies of all Site Inspection Reports (or equivalent thereof) issued by the TABA and the responses by any and all parties, relevant to the Inspection Reports. In addition, shall there have been RFI’s & Change Orders affecting the TAB work, they shall be included.

D. Copies of the approved performance curves, charts, etc., on all fans, coils, RTU’s, etc. shall be included in a separate section or appendix of the TAB report. It is the responsibility of the Architect and Consulting Engineer to provide “approved” copies of the appropriate submittal/performance data of the equipment involved in the installation. They shall also provide copies of the appropriate drawings and specifications, addenda, change borders, etc., required by the TABA to perform their work.
E. Report Forms: Forms utilized shall be significantly similar to the forms of the AABC National Standards.

1.5 QUALIFICATION AND QUALITY CONTROL

A. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and the AABC Procedures Manual; these shall be considered the minimum criteria. Agencies shall be certified by AABC and all work shall be performed under the direct field supervision of an AABC certified TBE.

B. The successful TABA shall be immediately provided with the necessary contract drawings, approved submittal data, etc., required to enable their critique of the contract drawings, addenda and specifications with respect to determining the “balance-ability” of the systems. This report shall be given to the Owner, Architect and Engineer. The TABA shall expedite this important aspect of TAB services.

1.6 GENERAL SCOPE OF WORK

A. Testing, Adjusting and Balancing of the heating, ventilating and air conditioning (HVAC) systems.

B. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and shall be considered the minimum criteria. These Standards are to be used and applied on the appropriate scope of the systems utilized and installed in and on this project. The TABA shall be totally familiar with these Standards and further detailed directions will not be provided unless specifically stated herein.

C. Test & Balance Agencies (TABA) shall be certified by the AABC, and all work shall be performed under the direct field supervision of an AABC certified TBE. All TABA firms shall have a permanent office in So. Nevada, locally manned with certified personnel and a Test & Balance Engineer. The TABA shall have been a member agency in good standing with their association for a minimum of three (3) years.

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.8 COORDINATION

A. Contractor and the Contractor’s representatives shall coordinate the systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. BAS, Commissioning/Lab Air Valve Control Agency will coordinate with TABA.

1.9 RESPONSIBILITY OF CONTRACTOR

A. Should the TABA be unable to perform his work or be required to redo his work because HVAC System(s) (elements, components or subsystems) are not ready or are improperly installed, any additional costs, herein related and approved by the owner, shall be back
charged to the Contractor.

B. Contractor and all Sub-Contractors shall cooperate fully with the TABA to efficiently complete the systems and their balancing.

C. Other than their instrumentation, gauges, etc., the TABA shall not provide nor install any devices or components. It is the responsibility of the Contractor to ensure the necessary assistance and coordination is provided which shall include (but not limited to):

1. Calibration of all controls (includes providing of instrumentation and software necessary to the operation of same, i.e. computers, etc.), providing and installing of drives, dampers, filters, access, test holes, gauges and taps (properly located), sealing of holes and insulation, removal and replacement of ceiling and/or tiles, water systems cleaned and flushed, duct leakage and pressure testing, proper motor starters and heaters installed, volume, fire and smoke/fire dampers, diffusers, grilles. All duct-mounted dampers shall be placed and locked in a full open position and clearly "flagged" for ease of location. The ceiling tile shall be clearly and permanently ID’d, for everyone’s knowledge of access. Hard ceilings shall be provided with permanent access. Where required the contractor(s) shall provide the necessary and adequate lifts and scaffolds.

2. All systems shall be checked, tested and started prior to turning them over to the TABA, and the report of same, in writing, provided to the TABA, as well as the owner. Contractor shall have a competent technician or tradesmen available during the testing and balancing of the systems. There shall be an HVAC technician, fully familiar with the systems, on site full time during the work of the TABA.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine strainers for clean screens and proper perforations.

F. Examine control valves for proper installation for their intended function of fluid flows.

G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

H. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

I. Examine equipment for installation and for properly operating safety interlocks and controls.

J. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

K. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in AC unit, and variable-air-volume air valve units.
4. Automatic modulating and shutoff valves, including 2-way valves are properly connected.
5. Sensors are located to sense only the intended conditions.
6. Sequence of operation for control modes is according to the Contract Documents.
7. Controller set points are set at design values. Observe and record system
reactions to changes in conditions. Record default set points if different from design values.

8. Interlocked systems are operating.

9. Changeover from heating to cooling mode occurs according to design values.

1.10 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance.

B. Forms shall include the following information:

1. Title Page:
   a. Company name
   b. Company address
   c. Company telephone number
   d. Project name
   e. Project location
   f. Project Engineer
   g. Project Contractor
   h. Project altitude

2. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model
   d. Serial number
   e. Range
   f. Calibration date

3. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Return/Exhaust air flow, specified and actual
   f. Outside/Supply air flow, specified and actual
   g. Total static pressure (total external), specified and actual
   h. Inlet pressure
   i. Discharge pressure
   j. Fan RPM

4. Return/Exhaust Air-Outside/Supply Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow
   d. Design return/exhaust air flow
   e. Actual return/exhaust air flow
   f. Design outside/Supply air flow
   g. Actual outside/Supply air flow
   h. Return/exhaust air temperature
   i. Outside/Supply air temperature
   j. Required mixed air temperature at face and by-pass dampers
   k. Actual mixed air temperature at face and by-pass damper
   l. Design supply/exhaust air ratio
   m. Actual supply/exhaust air ratio
   n. VFD status (% or Hz)

5. Electric Motors:
   a. Manufacturer
   b. HP/BHP
   c. Phase, voltage, amperage; nameplate, actual, no load.
   d. RPM
   e. Service factor
   f. Starter size, rating, heater elements
   g. V-Belt Drive:
h. Identification/location
i. Required driven RPM
j. Driven sheave, diameter and RPM
k. Belt, size and quantity
l. Motor sheave, diameter and RPM
m. Center to center distance, maximum, minimum, and actual

6. Heating Coil Data (AC Units and Unit Heaters):
a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Entering air temperature, design and actual
g. Leaving air temperature, design and actual
h. Air pressure drop, design and actual

7. Duct Traverse:
a. System zone/branch
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 Distribution Test Sheet:
a. Air Valve terminal number (supply, general exh., rack exh. And hood exh.)
b. Fume Hood air flow (face velocity, sash open and close)
c. Room number/location
d. Terminal type
e. Terminal size
f. Area factor
g. Design velocity
h. Design air flow
i. Test (final) velocity
j. Test (final) air flow
k. Percent of design air flow

1.11 WARRANTY
A. General Warranty.
B. Provide one-year full warranty from date of, Substantial Completion.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 EXECUTION
A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers,
are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine system and equipment test reports.

E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing, and Report all deficiencies to Architect/Owner.

G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine air valve terminal units, to verify that they are accessible and their controls are connected and functioning.

I. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures to Architect/Owner.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures:
   1. Before commencing work, as best as can be done, verify that systems are complete, operable and ready to balance. The TABA shall not begin their work until they (and the Owner) have received, in writing, from the installing contractors and the commissioning agency, that all of the systems have been completed, checked, tested and started and are completely ready for the TABA to begin their work.

B. The TABA shall make a minimum of three (3) site inspection visits during the systems installation. A written report (Site Inspection Report) of these inspections shall be sent to the Owner, Architect, Consulting Engineer and Contractor(s).

C. During the course of the work performed by the TABA, they shall provide Site Inspection Reports, daily if necessary, which shall report any defects, deficiencies or abnormal conditions observed in the systems, which may prevent systems balance, or compromise the proper operation of the systems. These reports shall be sent via fax, Email, by the following workday, to the Owner, Architect, Consulting Engineer and Contractor(s). Additionally, the prime Contractor shall provide a three-ring binder, on site, wherein copies of these reports/inspections shall be placed for the use of the contractors, inspectors or others.

D. Each of the above-notified parties shall document acceptance and receipt of these Reports by signing same, and returning that document to the owner or his representative and the TABA.

E. Recorded data shall represent actually measured or observed conditions and appropriate ambient conditions.
F. The intent and goal of testing and balancing is to have a completed system(s) functioning per design and has no deficiencies. The fullest cooperation between the TABA, BAS, Commissioning Agency and the Contractor and his trades is essential.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.

B. The TABA shall permanently mark settings of valves, dampers and other adjustment devices. Set and lock memory stops and mark them. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder (6 copies), tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing Engineer.

C. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to the certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
   5. All sight inspection and deficiency reports done by TABA.

E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name, address, and approval stamp.
   7. Contractor's name and address.
   9. Signature of testing, adjusting, and balancing Agent who certifies the report.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Cellular glass.
      b. Flexible elastomeric.
      c. Mineral fiber.
      d. Polysiocyanurate.
   2. Insulating cements.
   3. Adhesives.
   5. Lagging adhesives.
   7. Factory-applied jackets.
   8. Field-applied jackets.
   10. Securements.
   11. Corner angles.

B. Related Sections:
   1. Division 22 Section "Plumbing Insulation."
   2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   3. Detail removable insulation at piping specialties, equipment connections, and access panels.
   4. Detail application of field-applied jackets.
   5. Detail application at linkages of control devices.
   6. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
   1. Maximum Temperature: Able to withstand temperatures up to 160 degF.
E. Field quality-control reports.

F. Acoustical duct liner.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Comply with requirements in Part 3 schedule articles for where insulating
materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Thickness for foam having K-factor of 0.165 may be required from that indicated for mineral fiber insulation having K-factor of 0.24 provided the equivalent thermal resistance is maintained.

H. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.
      b. Owen Corning
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

I. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

J. Mineral-Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket. For equipment applications, provide insulation without factory-applied jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.

K. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000 Pipe Insulation.
      d. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a
thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

M. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Chemical Company (The); Trymer.
   b. HiTherm
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.165 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
   a. Pipe Applications: ASJ-SSL.
   b. Equipment Applications: ASJ-SSL.

2.2 INSULATING CEMENTS

   1. Products: Subject to compliance with requirements, provide one of the following
      a. Insulco, Division of MFS, Inc.; Triple I.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Insulco, Division of MFS, Inc.; SmoothKote.
      c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Childers Products, Division of ITW; CP-96.

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products
   b. Ductmate Industries
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Childers Products, Division of ITW; CP-82.
      c. Ductmate Industries
      d. Design Polymenics

   1. Products: Subject to compliance with requirements, provide one of the following
      a. Childers Products, Division of ITW; CP-82.
      c. Ductmate Industries
      d. Design Polymenics

F. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Childers Products, Division of ITW; CP-35.
      b. Foster Products Corporation, H. B. Fuller Company; 30-90.
      c. ITW TACC, Division of Illinois Tool Works; CB-50.
      d. Marathon Industries, Inc.; 590.
      e. Mon-Eco Industries, Inc.; 55-40.
      f. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Products: Subject to compliance with requirements, provide one of the following
      a. Childers Products, Division of ITW; CP-52.
      b. Foster Products Corporation, H. B. Fuller Company; 81-42.
      c. Design Polymenics
      d. Ductmate Industries
   2. Fire-resistant, water-based lagging adhesive and coating for use indoors to
adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.

3. **Service Temperature Range**: Minus 50 to plus 180 deg F.
4. **Color**: White.

### 2.6 SEALANTS

**A. Joint Sealants:**
1. **Joint Sealants for Cellular-Glass and Polyisocyanurate Products**: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Ductmate Industries
2. **Materials shall be compatible with insulation materials, jackets, and substrates.**
3. **Permanently flexible, elastomeric sealant.**
4. **Service Temperature Range**: Minus 100 to plus 300 deg F.
5. **Color**: White or gray.

**B. FSK and Metal Jacket Flashing Sealants:**
1. **Products**: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
2. **Materials shall be compatible with insulation materials, jackets, and substrates.**
3. **Fire- and water-resistant, flexible, elastomeric sealant.**
4. **Service Temperature Range**: Minus 40 to plus 250 deg F.
5. **Color**: Aluminum.

**C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:**
1. **Products**: Subject to compliance with requirements, provide one of the following
   a. Childers Products, Division of ITW; CP-76.
2. **Materials shall be compatible with insulation materials, jackets, and substrates.**
3. **Fire- and water-resistant, flexible, elastomeric sealant.**
4. **Service Temperature Range**: Minus 40 to plus 250 deg F.
5. **Color**: White.

### 2.7 FACTORY-APPLIED JACKETS

**A. Insulation system schedules indicate factory-applied jackets on various applications.** When factory-applied jackets are indicated, comply with the following:
1. **ASJ**: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. **ASJ-SSL**: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. **FSK Jacket**: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. **FSP Jacket**: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. **PVDC Jacket for Indoor Applications**: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   a. **Products**: Subject to compliance with requirements, provide one of the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 0.03-inch thick; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.

3. Thickness: 11.5 mil.


5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.

3. Thickness: 6.5 mils.


5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4) Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Childers Products.
      c. PABCO Metals Corporation.
      d. RPR Products, Inc.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B 209 Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with
requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Division 07 Section "Thermal and Moisture Protection" firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Pipe: Install insulation continuously through floor penetrations.
   3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Thermal and Moisture Protection".

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except
where more specific requirements are specified in various pipe insulation material installation articles.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not over compress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o’clock positions on the pipe.
   2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
   3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:
   1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
   2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
   3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
   4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for “fishmouthing,” and use PVDC tape along lap seal to secure joint.
   5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material:
   Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
TABLE 23 07 00-A
PIPE INSULATION SCHEDULE
INSULATION THICKNESS FOR NOMINAL PIPE SIZES

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEMP.</th>
<th>RANGE</th>
<th>1 AND 1-1/4</th>
<th>2-1/2</th>
<th>6 AND UP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LESS TO 2</td>
<td>IN.</td>
<td>IN.</td>
<td>IN.</td>
<td>IN.</td>
</tr>
<tr>
<td>Condensate</td>
<td>Any</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>--</td>
</tr>
<tr>
<td>Drain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather shall be provided with aluminum covering.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
   1. None.

D. Piping, Exposed (Including Mechanical Rooms):
   1. PVC: 0.03 inches thick.
   2. Aluminum, Smooth: 0.016 inch.

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.
TABLE 23 07 00-C
DUCT INSULATION SCHEDULE

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LOCATION</th>
<th>INSULATION</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Air</td>
<td>Concealed/</td>
<td>Glass Fiber</td>
<td>All Service</td>
</tr>
<tr>
<td>Heating &amp; Cooling</td>
<td>Exterior</td>
<td>2 Inch</td>
<td>Flexible</td>
</tr>
<tr>
<td>Supply Air</td>
<td>Exposed</td>
<td>Glass Fiber</td>
<td>Flexible Coating</td>
</tr>
<tr>
<td>Heating &amp; Cooling</td>
<td>in Cooled &amp;</td>
<td>1-1/2 Inch</td>
<td>Per 2.1</td>
</tr>
<tr>
<td></td>
<td>Heated Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return Air</td>
<td>Concealed In</td>
<td>Glass Fiber</td>
<td>All Service</td>
</tr>
<tr>
<td></td>
<td>Uncooled Or</td>
<td>1-1/2 Inch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexible</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In Unheated Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return Air</td>
<td>Concealed Or</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Exposed In</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In Cooled And</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heated Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return Air</td>
<td>Exposed In</td>
<td>Glass Fiber</td>
<td>Per 2.1</td>
</tr>
<tr>
<td></td>
<td>Uncooled Or</td>
<td>Flexible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unheated Space</td>
<td>1-1/2 Inch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Or Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation, Rooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside Air</td>
<td>All</td>
<td>Glass Fiber</td>
<td>Flexible Coating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Inch</td>
<td>Per 2.1</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

TABLE 23 07 00-D
EQUIPMENT INSULATION SCHEDULE

<table>
<thead>
<tr>
<th>Cooled Equipment</th>
<th>Insulation</th>
<th>Finish Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioning</td>
<td>Glass Fiber-Coated</td>
<td>Glass Cloth With</td>
</tr>
<tr>
<td>Equipment Housings,</td>
<td>Semi-Rigid Board</td>
<td>Vapor Barrier</td>
</tr>
<tr>
<td>Interior Insulation,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Inch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

END OF SECTION
SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Division 09 - Painting.

C. Section 23 05 53 –Identification for HVAC system

D. Section 23 05 48 - Vibration And Seismic Control

E. Section 23 07 00 – HVAC Insulation

1.02 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

   1. Heating-water piping.
   2. Air-vent piping.

B. Related Sections include the following:

   1. Division 23 Section for motors, and accessories for hydronic piping.

1.03 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.04 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

   1. Hot-Water Heating Piping: 150 psig at 200 deg F.
   2. Air-Vent Piping: 200 deg F.
   3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.05 SUBMITTALS
A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
5. Air control devices.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the
appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply
with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.07 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and
for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control
valve, Include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 – PRODUCTS(All steel pipe, copper tube and fittings shall be U.S.A. manufactured).

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings: ASME B16.22.

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

   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic Company of America.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze
   casting.

3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated;
gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves,
   EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and
   nuts.

D. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness
   as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3
   "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in
   Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3
   "Piping Applications" Article.
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, andfacings:

2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Victaulic Company of America.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

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

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

   b. Central Plastics Company.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

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

   b. Central Plastics Company.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

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

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Calpico, Inc.
   b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23.

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 and drawings.

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
8. Handle Style: Lever, with memory stop to retain set position.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.
   g. Tour & Andersson.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
9. Handle Style: Lever, with memory stop to retain set position.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
8. Inlet Strainer: removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Flow Design Inc.
   b. Griswold Controls.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
9. Maximum Operating Temperature: 200 deg F.

2.06 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Wessels

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS ½”.
5. Discharge Connection: NPS 1/8”.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:
1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS ½”.
5. Discharge Connection: NPS ¼”.
7. Maximum Operating Temperature: 240 deg F.

2.07 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger shall be any of the following:
   1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints. (Not for use in Boiler/Chiller rooms)

C. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

D. Safety-Valve-Inlet and Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.02 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for
installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

G. Locate valves for easy access and operation: where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.

H. Do not locate valves with stems below horizontal.

3.03 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4” ball valve, and short NPS 3/4” threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the
branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2” and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2” and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2” and larger. Match size of strainer blow off connection for strainers smaller than NPS 2”.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.04 PIPES OVER ELECTRICAL EQUIPMENT

A. Do not run piping over electrical equipment.

3.05 CHECK FOR INTERFERENCES WITH OTHER TRADES

A. Before installing piping, check existing condition and architectural, structural, mechanical, electrical, and fire protection drawings as applicable. MAKE ACCURATE LAYOUT OF ALL PIPING, INCLUDING INSTALLED ELEVATIONS. Submit copies of final layout to other trades for checking and coordinating with their work so that grouped pipes, conduit, and ducts will not interfere with each other, or with full swing doors and will leave minimum headroom as indicated. Coordination of the plumbing piping is the responsibility of this section.

3.06 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer,
supported on a trapeze.

4. Spring hangers to support vertical runs.

5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4": Maximum span, 7 feet; minimum rod size, 1/4 inch
2. NPS 1": Maximum span, 7 feet; minimum rod size, 1/4 inch
3. NPS 1-1/2": Maximum span, 9 feet; minimum rod size, 3/8 inch
4. NPS 2": Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2": Maximum span, 11 feet; minimum rod size, 3/8 inch
6. NPS 3": Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4": Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6": Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8": Maximum span, 19 feet; minimum rod size, 5/8 inch.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4": Maximum span, 5 feet; minimum rod size, 1/4 inch
2. NPS 1": Maximum span, 6 feet; minimum rod size, 1/4 inch
3. NPS 1-1/2": Maximum span, 8 feet; minimum rod size, 3/8 inch
4. NPS 2": Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2": Maximum span, 9 feet; minimum rod size, 3/8 inch
6. NPS 3": Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.07 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry sealthreading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.


H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or rollgrooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipewall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.08 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2" and larger.

E. Install air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 "bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4” pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.09 TERMINAL EQUIPMENT CONNECtIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."
3.10 CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building ServicesPiping."
   5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing. Make pressure tests in the presence of the Owner representative. Perform all pressure tests with the use of a Bristol Recording gauge, and a record of all test kept for handover to UNLV.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.
   4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   5. Set temperature controls so all coils are calling for full flow.
   6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
   7. Verify lubrication of motors and bearings.
SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.
8. Medium Pressure Ductwork

B. Related Sections:
1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section “Air Duct Accessories” for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
1. SMACNA + 2.0” w.g. static pressure class and 2500 FPM maximum velocity.
   a. Relief air ductwork.
   b. Outside air ductwork.
   c. Supply air ductwork from VAV terminals to air devices.
2. SMACNA - 2.0” w.g. static pressure class and 2500 FPM maximum velocity.
   a. Return air ductwork.
   b. Outside air ductwork.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and ASCE 7.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.
4. Duct Construction Standards

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE


B. Welding Qualifications: Qualify procedures and personnel according to the following:
PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

   a. ASI
   b. SEMCO
   c. United McGill

2. Single Wall Round Duct:
   a. Anvil Gruvlok
   b. Grinnell
   c. Shurjoint Piping Products, Inc.
   d. Victaulic Company

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEAMS AND JOINTS

A. Longitudinal seams shall be Pittsburgh, or equal (no known equal) lock with 3/8 inch minimum pocket.

B. Round Ductwork: Transverse joints in low pressure round ducts to be beaded sleeve joint secured with sheet metal screws equally spaced on 6 inch centers maximum with a minimum of 3 screws per joint. Round duct elbows shall be stamped or segmented; adjustable elbows are not acceptable. Seal joints with sealant.

C. Rectangular Ductwork: Construct all seams and joints in rectangular ductwork in accordance with SMACNA "HVAC Duct Construction Standards,". Seal all transverse joints with duct sealant.

D. Seal each duct transverse joint and longitudinal seam with a duct sealant. Use hard cast DT tape with RTA adhesives or equal (no known equal), for exterior ductwork.

2.5 FITTINGS FOR MEDIUM PRESSURE DUCTS

A. Elbows: All elbows shall have an inside radius not less than the width of the ducts in the direction of the curve. Where space conditions do not permit a full radius elbow, changes in direction shall be made using mitered elbows with multiple double thickness turning vanes.

   Construct radius elbows in accordance with the "HVAC Duct Construction Standards,". Short radius elbows are not allowed.

   Construct vaned elbows of double vanes in accordance with the "HVAC Duct Construction Standards,". Single vane elbow shall not be used.
B. Construct transitions and offsets in accordance with the "HVAC Duct Construction Standards."

Transitions: Maintain full duct cross section areas through transitions. Angle between centerline and side of diverging transition shall be no greater than 15 degrees in lieu of 20 degrees shown in the "Low Pressure Duct Manual." Angle between centerline and side of converging transition shall be no greater than 30 degrees.

Offsets: Construct with inside radii not less than the width of the duct in the direction of the curbs. Mitered elbows as specified under Subparagraph, "Elbows," herein may be used where space is restricted.

C. Collar taps for air outlet connections on exposed ductwork to be made with joint connection folded over inside of main duct and without exposed flanges. Outlet collar to be of same dimension as outside dimension of air outlet frame.

D. Make branch connections in accordance with SMACNA and as otherwise indicated on the Drawings.

E. Outlet Frames: Where ducts terminate at grilles, registers or diffusers, furnish with angle or channel iron frames with mitered welded corners and with provisions for attaching said grilles, registers, or diffusers.

F. Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Size doors for maintenance of concealed items. Construct access doors in accordance with "HVAC Duct Construction Standards." Furnish hinged doors except where space does not allow the door to swing open furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.

G. Make connections between ductwork and outlets with flexible duct material herein specified. (Unless otherwise specified on drawings).

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Thickness:
   a. 1/2 inch-VAV box internal insulation/lining.
   b. 1 inch-First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
   c. 2 inch-First 20 feet from air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans.
4. Metal Liner: Ductwork provided with internal sound lining at connections to air handling units or fans shall have a perforated galvanized metal inner liner covering the sound liner.

5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

6. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
2. Type: S.
3. Grade: NS.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
F. Trapeze and Riser Supports:

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Ductmate Industries, Inc.
   3. Hilti Corp.
   5. Mason Industries.
   6. TOLCO; a brand of NIBCO INC.
   7. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

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. (Unless otherwise specified on drawings).

Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

Adhere to Drawings: Run and shape of ducts offsets during progress of work may be varied, if required to meet structural or other interferences, as approved.

Install ductwork in adherence to ceiling height shown on Drawings. Establish necessary space requirements so as to maintain required clearances around all equipment.

Reinforce all ducts to prevent buckling, breathing, vibrations or noise, such reinforcing shall be as recommended in the reference specified herein.

3.2 SEAM AND JOINT SEALING

Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.3 HANGER AND SUPPORT INSTALLATION

Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Chapter 4, "Hangers and Supports."

Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. **Hanger Spacing:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. **Hangers Exposed to View:** Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE 7.
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. **Attachment to Structure:** If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. **Drilling for and Setting Anchors:**
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   2. Test the following systems:
      a. Supply air.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before insulation application.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   6. Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing agency which will be contracted by the Owner can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.
   7. Test Equipment: Use equipment arranged as recommended by the testing and balancing agency specified in Section 23 05 93.
   8. Field Test Procedures
      a. Seal all openings in duct section to be tested.
      b. Connect test apparatus to test section of duct, using a flexible duct connection or hose.
      c. Close damper or blower suction side to prevent excessive build up of pressure.
      d. Start blower and gradually open damper on suction side of blower.
      e. Build up pressure in duct test section to 4 inches WG.
      f. Record indicated pressure or instrument that is connected to section of duct under test.
      g. Maintain this pressure for ten minutes and check for audible leaks. Mark location of each leak.
      h. Reduce pressure to 0 inch WG and repair all visual and audible leaks.
i. Upon completion of repairs, build up pressure to design operating pressure, and read leakage pressure on instrument connected across test apparatus orifice.

j. Leakage C.F.M. to be read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential shall be indicated. Leakage C.F.M. shall not exceed 3%. Repeat procedure as indicated above until leakage rate is met.

9. Engage the testing agency specified in Section 23 05 93, to verify the leakage tests of all ducts and submit a certification attesting to the results obtained.

10. Tested sections of ductwork to be visually marked by agency with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to “Vacuum Test” in NADCA ACR, “Assessment, Cleaning and Restoration of HVAC Systems.”
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Adjustment and cleaning.
   1. Balancing and Adjusting: Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Intermediate Reinforcement:

C. Liner:
   1. 1/2 inch-VAV box internal insulation/lining.
   2. 1 inch-First 10 feet from VAV box discharge and first 15 feet from exhaust fan inlet, or as indicated on plans.
   3. 2 inch-First 20 feet from rooftop air handling unit supply, return, outside air and relief air connections and first 20 feet from return/relief air fan inlet and outlet connections, or as indicated on plans.

D. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 with turning vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Mitered Type RE 2 with vanes complying with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanels and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionally fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

E. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: 45 degree entry with transition to round.
   2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
      a. Velocity 1000 fpm or Lower: 45 degree lateral
      b. Velocity 1000 to 1500 fpm: 45 degree lateral.
      c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

B. Backdraft and pressure relief dampers.

C. Barometric relief dampers.


E. Control dampers.

F. Fire dampers.

G. Combination fire and smoke dampers.

H. Flange connectors.

I. Duct silencers.

J. Turning vanes.

K. Remote damper operators.

L. Duct-mounted access doors.

M. Flexible connectors.

N. Duct accessory hardware.

O. Related Sections:

P. Division 28 Section for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

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

B. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

D. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and
method of field assembly into duct systems and other construction.

1. Include the following:
   a. Special fittings.
   c. Control damper installations.
   d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
   e. Duct security bars.
   f. Wiring Diagrams: For power, signal, and control wiring.

E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

F. Source quality-control reports.

G. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

C. Galvanized Coating Designation: G60.

D. Exposed-Surface Finish: Mill phosphatized.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.

F. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
G. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

H. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

I. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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

B. Greenheck Fan Corporation.

C. Nailor Industries Inc.

D. Ruskin Company.

E. Potorff

F. Description: Gravity balanced.


H. Maximum System Pressure: 2-inch wg.

I. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

J. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

K. Blade Action: Parallel.

L. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

M. Blade Axles:

N. Material: Galvanized steel.

O. Diameter: 0.20 inch.

P. Tie Bars and Brackets: Aluminum.

Q. Return Spring: Adjustable tension.

R. Bearings: Steel ball or synthetic pivot bushings.

S. Accessories:

T. Adjustment device to permit setting for varying differential static pressure.

U. Counterweights and spring-assist kits for vertical airflow installations.

V. Electric actuators.
W. Chain pulls.
X. Front of rear screens.
Y. 90-degree stops.
Z. Sleeve: Minimum 20-gage thickness.

2.3 BAROMETRIC RELIEF DAMPERS

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

B. Greenheck Fan Corporation.
C. Nailor Industries Inc.
D. Ruskin Company.
E. SEMCO Incorporated.
F. Suitable for horizontal or vertical mounting.
H. Maximum System Pressure: 2-inch wg.
I. Frame: 0.064-inch-thick, galvanized sheet steel, with welded corners and mounting flange.
J. Blades:
K. Multiple, 0.025-inch-thick, roll-formed aluminum.
L. Maximum Width: 6 inches.
M. Action: Parallel.
N. Balance: Gravity.
O. ECCentricaly pivoted.
P. Blade Seals: Vinyl or Neoprene.
Q. Blade Axles: Galvanized steel.
R. Tie Bars and Brackets:
S. Material: Aluminum.
T. Rattle free with 90-degree stop.
U. Return Spring: Adjustable tension.
V. Bearings: Bronze.
W. Accessories:
X. Flange on intake.
Y. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flexmaster U.S.A., Inc.
      b. McGill AirFlow LLC.
      c. METALAIRE, Inc.
      d. Nailor Industries Inc.
      e. Ruskin Company.
   2. Standard leakage rating.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements:
      a. Flexmaster U.S.A., Inc.
      b. McGill AirFlow LLC.
      c. METALAIRE, Inc.
      d. Nailor Industries Inc.
      e. Ruskin Company.
   2. Suitable for horizontal or vertical applications.
   3. Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
   4. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
      e. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
   6. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   7. Tie Bars and Brackets: Aluminum.
2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements:

B. Ductmate Industries, Inc.

C. Nexus PDQ

D. Ward Ind.

E. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

F. Material: Galvanized steel.

G. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements:

1. Ductmate Industries, Inc.

2. Duro Dyne Inc.

3. METALAIRE, Inc.

4. SEMCO Incorporated.


B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.


C. General Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.7 REMOTE DAMPER OPERATORS

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

1. Pottorff; a division of PCI Industries, Inc.

2. Ventfabrics, Inc.

3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches deep.

F. Wall-Box Cover-Plate Material: Steel.

2.8 DUCT-MOUNTED ACCESS DOORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabs, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. **Frame**: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. **Outdoor Spring Diameter**: Not less than 80 percent of the compressed height of the spring at rated load.
3. **Minimum Additional Travel**: 50 percent of the required deflection at rated load.
4. **Lateral Stiffness**: More than 80 percent of rated vertical stiffness.
5. **Overload Capacity**: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. **Elastomeric Element**: Molded, oil-resistant rubber or neoprene.
7. **Coil Spring**: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

### 2.10 DUCT ACCESSORY HARDWARE

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

1. Ductmate Industries, Inc.
2. Nexus PDQ
3. Ward Industries

**B. Instrument Test Holes**: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

**C. Adhesives**: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

**A.** Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

**B.** Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

**C.** Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

**D.** Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hatchannel.

1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts".
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

**E.** Set dampers to fully open position before testing, adjusting, and balancing.

**F.** Install test holes at fan inlets and outlets and elsewhere as indicated.

**G.** Install fire and smoke dampers according to UL listing.

**H.** Connect ducts to duct silencers rigidly.
I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Adjacent to and close enough to fire or smoke dampers.
   3. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

Q. Install duct test holes where required for testing and balancing purposes.
   1. Cut or drill temporary test holes in ducts as required. Cap with threaded metal caps.
   2. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION#
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following: Backdraft and pressure relief dampers.
   1. centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
   Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings

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.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Size and location of initial access modules for acoustical tile.
   3. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 MAINTENANCE AND EMERGENCY SERVICE

A. Provide regular maintenance for the contract period from start up of the equipment through completion of the 12-month warranty period. Maintenance service for equipment shall be provided based on the manufacturer's recommendations, but at least every two months.

B. Regular maintenance shall include a minimum of six filter replacement and a minimum of one drive belt replacement.

C. Provide 24-hour emergency service for breakdowns and malfunctions. An emergency number shall be provided to the owner. A call back response shall be within four (4) hours of the phone call.

D. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.

1.9 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. Belts: One set for each belt-driven unit.
PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Ventilation.

C. Description: belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Accessories:
   1. Companion Flanges: For inlet and outlet duct connections.
   2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
   3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

F. Capacities and Characteristics: Refer to the Drawings

2.2 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using restrained spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  10. Shut unit down and reconnect automatic temperature-control operators.
  11. Remove and replace malfunctioning units and retest as specified above.
B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.5 UNIT TEST

A. The fans shall be factory run tested to insure structural integrity. The factory run test shall be conducted to examine unit operation and minimum vibration levels as specified.

B. The following tests shall be performed:
   1. Unit operation and vibration analysis. The unit fans shall be operated at the unit design RPM and a complete vibration spectrum shall be conducted as specified in the section covering unit fan. Any fan, motor, drive and base assembly vibration shall be brought to within specified levels. Fan tests as conducted in the fan supplier's shop are not acceptable.
   2. A sound performance test shall be made on one of each type of exhaust fan prior to shipment of any air handler. The test shall be performed in an AMCA certified laboratory. The particular fan to be tested shall be at the discretion of the UNLV PM. The octave band sound power levels shall be determined in accordance with an ANSI standard procedure. Data shall be taken to verify, at the unit's full flow CFM and static pressure for the exhaust fan sound power levels. Test results to be submitted to UNLV PM for approval prior to shipment of any equipment.

END OF SECTION
SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Perforated diffusers.
   3. Adjustable bar grilles.
   4. Fixed face grilles.

B. Related Sections:
   1. Division 08 Section "Openings" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
   2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

E. Source quality-control reports.
PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
   2. Devices shall be specifically designed for variable-air-volume flows.
   4. Finish: Baked enamel, white.

B. Perforated Diffuser:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
   2. Devices shall be specifically designed for variable-air-volume flows.
   3. Material: Steel back pan and pattern controllers, with steel face.
   4. Finish: Baked enamel, white.

2.2 HIGH-CAPACITY DIFFUSERS

A. Drum Louver:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anemostat,
      b. Carnes Co.
      c. Krueger
      d. Metal-Aire
      e. Nailor Industries
      f. Price Industries
      g. Titus
      h. Tuttle & Bailey
   6. Gasket between drum and border.
   9. Mounting: Surface to duct.
2.3 REGISTERS AND GRILLS

A. Adjustable Bar Grill:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
   d. Metal-Aire
   e. Nailor Industries
   f. Price Industries
   g. Titus
   h. Tuttle & Bailey

2. Material: Steel
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
6. Rear-Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.
7. Frame: 1-1/4 inches (32 mm) wide.

B. Fixed Face Grill:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
   d. Metal-Aire
   e. Nailor Industries
   f. Price Industries
   g. Titus
   h. Tuttle & Bailey

3. Finish: Baked enamel, white.
7. Mounting: Countersunk screw.

C. Linear Bar Grill:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anemostat,
   b. Carnes Co.
   c. Krueger
   d. Metal-Aire
   e. Nailor Industries
   f. Price Industries
   g. Titus
   h. Tuttle & Bailey

3. Finish: Baked enamel, white.
2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. The work included in this division of the specifications consists of furnishing labor, tools, equipment, supplies, and materials unless otherwise specified, and in performing operations necessary for the installation of the complete Electrical System as required by these specifications or shown on the drawings, subject to the terms and conditions of the Contract. The work shall also include the completion of details of electrical work not mentioned or shown which are necessary for the successful operation of electrical systems described on the drawings or required by these specifications.

C. The Agreement, Bidding Documents, General Conditions of the Contract, Supplemental General Conditions, and other applicable portions of Division 1, and all Addenda issued prior to Agreement execution form a part of these specifications and apply to all Contracts or Subcontracts relating to the electrical systems.

1.02 REFERENCES


B. UNLV Standards.

C. State of Nevada Public Works.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Proposed Products List: Include Products specified in the following Sections:
   1. Section 26 05 34 – Floor Boxes for Electrical Systems.
   2. Section 26 05 73 – Overcurrent Protective Device Coordination Study
   3. Section 26 09 23 – Lighting Control Devices
   4. Section 26 22 00 – Low-Voltage Transformers
   5. Section 26 24 13 – Switchboards
   6. Section 26 24 16 – Panelboards
   7. Section 26 35 53 – Voltage Regulators
   8. Section 26 51 00 – Interior Lighting
   9. Section 26 56 00 – Exterior Lighting
   10. Section 27 11 00 – Communications for Equipment Room Fittings
   11. Section 27 13 00 – Communications for Backbone Cabling
   12. Section 27 15 00 – Communication Horizontal Cabling
   13. Section 28 13 00 – Access Controls
   14. Section 28 16 00 – Intrusion Detection
   15. Section 28 31 00 – Fire Detection and Alarm
C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittals.

D. Mark dimensions and values in units to match those specified.

1.04 REGULATORY REQUIREMENTS


B. Electrical: Conform to NFPA 70.

C. Obtain permits, and request inspections from authority having jurisdiction.

D. The Contractor shall obtain and pay for licenses and permits required, and shall pay for fees and charges for the connection to outside services and use of property other than the site of the work for storage of materials or other purposes.

E. The Contractor shall procure and maintain, at his expense, such insurance required by law and/or specified in the General Conditions.

F. All materials, products, devices, fixtures, forms or types of construction included in this project shall meet or exceed the published requirements of National Electrical Code (NEC), American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Fire Protection Association (NFPA) 70,99,101,110, and National Electrical Manufactures Associations (NEMA). All equipment shall bear the Underwriter’s (U.L.) label.

1.05 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. The drawings are diagrammatic unless indicated otherwise. The drawings reflect circuiting only and are not depicting exact conduit routing unless specifically noted otherwise. Homerun circuits may be combined per requirements of NEC. Do not share neutral conductors in Homerun unless specifically noted on Drawings.

C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.

D. Data presented on these drawings are as accurate as planning can determine, but field verification of all dimensions, locations, levels, etc., to suite field conditions is required. Review all architectural, interior, structural, civil, and mechanical drawings; and adjust all work to meet the requirements of conditions shown. Discrepancies between different plans, or between drawings and specifications, or regulations and codes governing the installation shall be brought to the attention of the engineer in writing before the date of bid opening. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustments will be made after contract award. Contractor shall be responsible to field measure and confirm mounting heights and location of electrical equipment with respect to counters, radiation, etc. Do not scale distances off the electrical drawings. Use actual building dimensions.

E. Guarantee all material furnished and all workmanship performed for a period of one year from the date of final acceptance of the work. Any defects developing with in this period,
traceable to material furnished as a part of this section or workmanship performed hereunder, shall be made good at no additional expense to the owner.

1.06 FIELD CHANGE ORDERS

A. All change orders for electrical equipment shall be priced in accordance with Mean's Electrical Cost Data for Change Orders 2014 Edition.

END OF SECTION
SECTION 26 05 03
EQUIPMENT WIRING CONNECTIONS

PART 1  GENERAL

1.01  SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:
   1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.02  REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03  COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2  PRODUCTS

2.01  CORD AND PLUGS

A. Attachment Plug Construction: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

C. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3  EXECUTION

3.01  EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.02 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.03 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION
SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes building wire and cable; and wiring connectors and connections.

B. Related Sections:
   2. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
   3. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.

1.02 REFERENCES

A. International Electrical Testing Association:

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:
   1. UL 1277 – Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.03 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
   2. Stranded conductors for control circuits.
   3. Conductor not smaller than 12 AWG for power and lighting circuits.
   4. Conductor not smaller than 14 AWG for control circuits.
   5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet and shorter than 149 feet.
   6. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 150 feet.
   7. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet and shorter than 329 feet.
   8. 8 AWG conductors for 20 ampere, 277 volt branch circuits longer than 330 feet.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN, XHHW insulation, in raceway.
   2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN, XHHW insulation, in raceway.
   3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN, XHHW insulation, in raceway.
   4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN, XHHW, insulation in raceway.
   5. Exterior Locations: Use only building wire, Type THW, XHHW, insulation in raceway.
6. Underground Locations: Use only building wire, Type THW, XHHW, insulation in raceway.

1.04 DESIGN REQUIREMENTS
A. Conductor sizes are based on copper.
B. Aluminum conductors are not allowed.

1.05 SUBMITTALS
A. See Division 1 for Submittal Procedures.
B. Product Data: Submit for building wire.
C. Test Reports: Indicate procedures and values obtained.

1.06 CLOSEOUT SUBMITTALS
A. See Division 1 for Submittal Procedures for Execution and Closeout Requirements: Requirements for submittals.
B. Project Record Documents: Record actual locations of components and circuits.

1.07 QUALITY ASSURANCE
A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
B. Perform Work in accordance with NECA’s Standard of Installation and in accordance with recognized industry practices.

1.08 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.09 FIELD MEASUREMENTS
A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION
A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

2.01 BUILDING WIRE
A. Manufacturers:
   1. Southwire Company.
2. Okonite.
3. Cable C.
5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper for sizes smaller than 2 AWG.

D. Insulation: 600 volt rating; material rated 75 degrees C.

E. Insulation Voltage Rating: 600 volts.

2.02 WIRING CONNECTORS

A. Provide UL-type, factory-fabricated, metal connector taps or splices of sizes, ampacity ratings, materials, types and classes for applications and services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following to fulfill project requirements:

1. Split Bolt Connectors.
2. Solderless Pressure Connectors.
3. Spring Wire Connectors.
4. Compression Connectors.

2.03 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger. Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Division 1 Administrative Requirements for Coordination and Project Conditions.

B. Verify interior of building has been protected from weather.

C. Verify mechanical work likely to damage wire and cable has been completed.

D. Verify raceway installation is complete and supported.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods as specified.

E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.04 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques-Building Wire in Raceway:
   1. Pull conductors into raceway at same time.
   2. Install building wire 4 AWG and larger with pulling equipment.

E. Special Techniques - Cable:
   1. Protect exposed cable from damage.
   2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
   3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:
   1. Clean conductor surfaces before installing lugs and connectors.
   2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   3. Each tap, joint, or splice in conductors No. 4 AWG and larger shall be taped with a minimum of two layers of rubber compound tape and three layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Insulation of splice shall match or exceed insulation level of conductors.
   4. Cable splices shall be made only in distribution and junction boxes.
   5. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers published torque tightening requirements. If not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.
   6. Splices shall not be made in feeders.

G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

H. Use stranded conductor, No. 8 AWG and layer for general use wiring.
   1. Use stranded conductor, No. 12 AWG and larger, for motors and other installations where vibration is generated and for wiring to manufactured equipment.
   2. Use stranded conductor, No. 14 AWG minimum for control wiring.
   3. Install crimp on fork terminals for stranded conductor device terminations. Do not place bare stranded conductors directly under screws.

I. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
J. Size lugs in accordance with manufacturer’s recommendations terminating wire sizes. Install 2-hole type lugs to connect wire 4 AWG and larger to copper bus bars.

K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

### 3.05 WIRE COLOR

A. General:

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 volts single or three phase.
   c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.

2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 volts single or three phase.
   c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White for 120/208 and gray for 277/480 volt circuits. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.
2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.
3. For isolated ground circuits: Green with yellow stripe.

### 3.06 FIELD QUALITY CONTROL

A. See Division 1 for Quality control requirements and for execution of Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section Includes:
   1. Rod electrodes.
   2. Wire.
   3. Mechanical connectors.
   4. Exothermic connections.

B. Related Sections:
   1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.

1.02  REFERENCES

A. Institute of Electrical and Electronics Engineers:
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.03  SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:
   1. Metal building frame.
   2. Concrete-encased electrode.
   3. Rod electrode.
   4. Metal underground water pipe.

1.04  PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.05  SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Product Data: Submit data on grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Manufacturer's Installation Instructions: Submit for active electrodes.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
1.06 CLOSEOUT SUBMITTALS

A. See Division 1 Submittal Procedures for execution and Closeout Requirements.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with NECA’s Standard of Installation.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.

1.09 PRE-INSTALLATION MEETINGS

A. See Division 1: Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. See Division 1 for Product Storage and Handling Requirements.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.11 COORDINATION

A. See Division 1 Administrative Requirements for Coordination and Project Conditions.

B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.01 ROD ELECTRODES

A. Manufacturers:
   1. Apache Grounding/Erico Inc.
   2. Copperweld, Inc.
   3. Erico, Inc.
   4. O-Z Gedney Co.
   5. Thomas & Betts, Electrical.
6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description:
   1. Material: Copper.
   3. Length: 10 feet.

C. Connector: Connector for exothermic welded connection.

2.02 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 4 AWG unless indicated on drawings.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.03 MECHANICAL CONNECTORS

A. Manufacturers:
   1. Apache Grounding/Erico Inc.
   2. Copperweld, Inc.
   3. Erico, Inc.
   4. O-Z Gedney Co.
   5. Thomas & Betts, Electrical.
   6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.04 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Apache Grounding/Erico Inc.
   2. Cadweld, Erico, Inc.
   3. Copperweld, Inc.
   4. ILSCO Corporation.
   5. O-Z Gedney Co.
   6. Thomas & Betts, Electrical.
   7. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Division 1: Administrative Requirements: Verification of existing conditions before starting work.

B. Verify final backfill and compaction has been completed before driving rod electrodes.
3.02 PREPARATION
   A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.03 EXISTING WORK
   A. Modify existing grounding system to maintain continuity to accommodate renovations.
   B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.04 INSTALLATION
   A. Install in accordance with IEEE 142.
   B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground. Drive ground rods to a depth of 12" below finished grade.
   C. Install grounding and bonding conductors concealed from view.
   D. Install 4 AWG unless noted otherwise bare copper wire in foundation footing.
   E. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.
   F. Bond together metal siding not attached to grounded structure; bond to ground.
   G. Install isolated grounding conductor for circuits indicated on drawings in accordance with IEEE 1100.
   H. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
   I. Install continuous grounding using building steel as grounding electrode. Install artificial station ground by means of driven rods or buried electrodes.
   J. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
   K. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
   L. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed conductor to grounding bus.
   M. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
   N. Permanently attach equipment and grounding conductors prior to energizing equipment.
O. Except for connections to ground bus bars, all grounding conductor to conductor, conductor to ground rod and conductor to structure connections of #6 AWG and larger copper conductors shall be permanent exothermically welded connections. Copper grounding conductors spliced with exothermic connections shall be considered as a continuous conductor, as stated in NEC 250-64(c).

P. Attach grounds to ground bus bars before permanent building service is energized.

Q. Ground metal lighting poles, as shown on drawings and as required by NEC.

R. When installing exposed runs, attach ground wire neatly and firmly to walls.

S. Step-down transformer secondaries shall be grounded to the nearest electrical room ground bus bar. Also, bond the grounded conductor of the transformer to the nearest available point of the interior metal water piping system in the area served by the transformer in accordance with NEC Article 250-104.

3.05 FIELD QUALITY CONTROL

A. See Division 1 for Quality Control Requirements and for execution of field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground resistance testing in accordance with IEEE 142.

E. Perform leakage current tests in accordance with NFPA 99.

F. Perform continuity testing in accordance with IEEE 142.

G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section Includes:
   1.  Conduit supports.
   2.  Formed steel channel.
   4.  Sleeves.
   5.  Mechanical sleeve seals.
   6.  Firestopping relating to electrical work.
   7.  Firestopping accessories.
   8.  Equipment bases and supports.

B.  Related Sections:
   1.  Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
   2.  Section 27 05 29 - Hangers and Supports for Communications Systems.

1.02  REFERENCES

A.  ASTM International:

B.  FM Global:

C.  National Fire Protection Association:
   1.  NFPA 70 - National Electrical Code.

D.  Underwriters Laboratories Inc.:
   3.  UL 1479 - Fire Tests of Through-Penetration Firestops.
   5.  UL - Fire Resistance Directory.

E.  Intertek Testing Services (Warnock Hersey Listed):
   1.  WH - Certification Listings.

1.03  DEFINITIONS

A.  Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.
1.04 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
   1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Surface Burning: ASTM E84 and UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of hangers and supports.

F. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.07 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
   2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor [and Roof] Assemblies: Materials to resist free passage of flame and products of combustion.
   2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with requirements of local jurisdiction.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.

1.09 PRE-INSTALLATION MEETINGS

A. See Division 1 Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. See Division 1 for Product Storage and Handling Requirements.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. See Division 1 Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas to receive solvent cured materials.
PART 2  PRODUCTS

2.01  CONDUIT SUPPORTS

A.  Manufacturers:
    1.  Allied Tube & Conduit Corp.
    2.  Electroline Manufacturing Company.
    3.  O-Z Gedney Co.
    4.  Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B.  Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C.  Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D.  Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E.  Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

2.02  FORMED STEEL CHANNEL

A.  Manufacturers:
    1.  Allied Tube & Conduit Corp.
    4.  Unistrut Corp.
    5.  Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B.  Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

2.03  SPRING STEEL CLIPS

A.  Manufacturers:
    1.  Allied Tube & Conduit Corp.
    4.  Unistrut Corp.
    5.  Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B.  Product Description: Mounting hole and screw closure.

2.04  SLEEVES

A.  Furnish sleeves and seals, including armored cable seals, of types, sizes, and materials with the following construction features.

B.  Sleeves for Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

C.  Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
D. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.05 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
5. Calpico, Inc.
6. Metraflex Co.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.06 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
7. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray.

2.07 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
B. Dam Material: Permanent:
1. Mineral fiberboard.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3  EXECUTION

3.01  EXAMINATION

A. See Division 1 Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.02  PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing and damming materials to arrest liquid material leakage.

D. Obtain permission from Structural Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

3.03  INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
7. Wood Elements: Provide wood screws.
B. Inserts:
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. 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.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
4. Support vertical conduit at every floor.

G. Placement of Hangers and Supports onto structural steel shall be coordinated with the structural engineer.

3.04 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Fire Rated Surface:
1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, bus, cable bus, conduit, wireway, or trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS
A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Section 03 30 00.
B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.06 INSTALLATION - SLEEVES
A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
C. Set sleeves in position in forms. Provide reinforcing around sleeves.
D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
G. Install chrome plated steel escutcheons at finished surfaces.

3.07 FIELD QUALITY CONTROL
A. See Division 1 for Quality Control Requirements and for execution of field inspecting, testing, adjusting, and balancing.
B. Inspect installed firestopping for compliance with specifications.
3.08 CLEANING

A. See Division 1 Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.09 PROTECTION OF FINISHED WORK

A. See Division 1 for Execution and Closeout Requirements for protecting installed construction.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:
   1. Section 26 05 03 - Equipment Wiring Connections.
   2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   4. Section 26 05 34 - Floor Boxes for Electrical Systems.
   5. Section 26 05 53 - Identification for Electrical Systems.
   6. Section 26 27 16 - Electrical Cabinets and Enclosures.
   7. Section 26 27 26 - Wiring Devices.
   8. Section 27 05 33 - Conduits and Backboxes for Communications Systems.
   9. Section 27 05 36 - Cable Trays for Communications Systems.
  10. Section 28 05 33 - Conduits and Backboxes for Electronic Safety and Security.
  11. Section 28 05 36 - Cable Trays for Electronic Safety and Security.

1.02  REFERENCES

A. American National Standards Institute:
   1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
   2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
   3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.03  SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.

C. In or Under Slab on Grade: Provide thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.
D. Outdoor Locations, Above Grade: Provide rigid steel conduit below 10’ and intermediate metal conduit and electrical metallic tubing for above 10’. Provide cast metal or nonmetallic outlet, pull, and junction boxes.

E. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit and electrical metallic tubing. Provide sheet metal boxes.

F. Wet and Damp Locations: Provide rigid steel conduit, intermediate metal conduit and electrical metallic tubing. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.


1.04 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 1/2 inch unless otherwise specified. All homeruns to panelboards shall be minimum size ¾ inch.

1.05 SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Product Data: Submit for the following:
   1. Flexible metal conduit.
   2. Liquidtight flexible metal conduit.
   3. Nonmetallic conduit.
   4. Flexible nonmetallic conduit.
   5. Raceway fittings.
   6. Conduit bodies.
   7. Wireway.
   8. Pull and junction boxes.

C. Manufacturer’s Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.06 CLOSEOUT SUBMITTALS

A. See Division 1: Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:
   1. Record actual routing of conduits larger than 2 inch.
   2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Division 1: Product Requirements: Product storage and handling requirements.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
C. Protect PVC conduit from sunlight.

1.08 COORDINATION

A. See Division 1: Administrative Requirements: Coordination and project conditions.
B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.01 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.
B. Rigid Aluminum Conduit: ANSI C80.5.
C. Intermediate Metal Conduit (IMC): Rigid steel.
D. Fittings and Conduit Bodies: NEMA FB 1; all steel fittings.

2.02 PVC COATED METAL CONDUIT

A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.03 FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction.
B. Fittings: NEMA FB 1.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction with PVC jacket.
B. Fittings: NEMA FB 1.

2.05 ELECTRICAL METALLIC TUBING (EMT)

A. Product Description: ANSI C80.3; galvanized tubing.
B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression set screw type.

2.06 NONMETALLIC CONDUIT

A. Product Description: NEMA TC 2; Schedule 40 and 80 PVC.
B. Fittings and Conduit Bodies: NEMA TC 3.
C. Product Description: General purpose type wireway.
D. Knockouts: Manufacturer's standard.
E. Size: As indicated on Drawings.
F. Cover: Hinged cover with full gaskets.
G. Connector: Slip-in.
H. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
I. Finish: Rust inhibiting primer coating with gray enamel finish.

2.07 OUTLET BOXES
A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.
B. Nonmetallic Outlet Boxes: NEMA OS 2.
C. Cast Boxes: NEMA FB 1, Type FD, cast ferroly. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
D. Wall Plates for Finished Areas: As specified in Section 26 27 26.
E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.08 PULL AND JUNCTION BOXES
A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
B. Hinged Enclosures: As specified in Section 26 27 16.
C. Concrete composite Handholes: Concrete composite hand holes:
   1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
   2. Cover: Concrete composite, weatherproof cover with nonskid finish.
   3. Cover Legend: “Electric”.

PART 3 EXECUTION
3.01 EXAMINATION
A. See Division 1 Administrative Requirements: Coordination and project conditions.
B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 EXISTING WORK
A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
B. Remove concealed abandoned raceway to its source.
C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.03 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

E. Conceal raceway except in mechanical or utility areas and where noted exposed.

3.04 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 26 05 29.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.

L. Maintain clearance between raceway and piping for maintenance purposes.

M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
O. Bring conduit to shoulder of fittings; fasten securely.

P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.

S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Close ends and unused openings in wireway.

3.05 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.
M. Support boxes independently of conduit.
N. Install gang box where more than one device is mounted together. Do not use sectional box.
O. Install gang box with plaster ring for single device outlets.

3.06 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
B. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
C. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.07 ADJUSTING

A. See Division 1 Execution and Closeout Requirements: Testing, adjusting, and balancing.
B. Adjust flush-mounting outlets to make front flush with finished wall material.
C. Install knockout closures in unused openings in boxes.

3.08 CLEANING

A. See Division 1 Execution and Closeout Requirements: Final cleaning.
B. Clean interior of boxes to remove dust, debris, and other material.
C. Clean exposed surfaces and restore finish.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes floor boxes; floor box service fittings; and poke-through fittings.

B. Related Sections:
1. Section 07 84 00 - Firestopping: Firestopping for electrical work.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems: Firestopping for electrical work.
3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
4. Section 26 27 26 - Wiring Devices: Receptacles for installation in floor boxes.

1.02  REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.03  SUBMITTALS

A. See Division 1 for Submittal procedures.

B. Product Data: Submit catalog data for floor boxes and service fittings.

1.04  CLOSEOUT SUBMITTALS

A. See Division 1 Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

1.05  QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06  EXTRA MATERIALS

A. See Division 1 Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two protective rings and split nozzles.

C. Furnish two carpet rings.
PART 2 PRODUCTS

2.01 FLOOR BOXES

A. Manufacturers:
   1. Walker Manufacturing.
   2. Steel City, Midland – Ross Corporation.
   3. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Floor Boxes: NEMA OS 1, 1-1/2 inches deep.

C. Adjustability: Fully adjustable.

D. Material: Formed steel.

E. Shape: Rectangular.

2.02 FLUSH-COVER-SERVICE FITTING ACCESSORIES

A. Manufacturers:
   1. Match Convenience Outlet Manufacturer.

B. Protective Ring: Brass finish.

C. Split Nozzle: Brass finish.

D. Carpet Ring: Brass.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Division 1 Administrative Requirements: Coordination and project conditions.

B. Verify locations of floor boxes and outlets in offices, and work areas prior to rough-in.

C. Verify openings in access floor are in proper locations.

3.02 EXISTING WORK

A. Disconnect abandoned service fitting devices and remove service fittings. Install blank cover for abandoned floor boxes not removed.

B. Maintain access to existing floor boxes remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing service fitting installations using materials and methods as specified.

D. Clean and repair existing service fittings to remain or to be reinstalled.
3.03 INSTALLATION

A. Boxes and fittings are indicated on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet to accommodate intended purpose.

B. Floor Box Requirements: Use cast or PVC floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

C. Set floor boxes level.

D. Install boxes and fittings to preserve fire resistance rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

E. Install protective rings on active flush cover service fittings.

3.04 ADJUSTING

A. See Division 1 Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust floor box flush with finish flooring material.

3.05 CLEANING

A. See Division 1 Execution and Closeout Requirements: Final cleaning.

B. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section Includes:
   1.  Nameplates.
   2.  Labels.
   3.  Wire markers.
   5.  Underground Warning Tape.

B.  Related Sections:
   1.  Section 09 90 00 - Painting and Coating: Execution requirements for painting
      specified by this section.
   2.  Section 27 05 53 - Identification for Communications Systems.

1.02  SUBMITTALS

A.  See Division 1 for Submittal Procedures.

B.  Product Data:
   1.  Submit manufacturer's catalog literature for each product required.
   2.  Submit electrical identification schedule including list of wording, symbols, letter
      size, color coding, tag number, location, and function.

C.  Samples:
   1.  Submit two samples of each type of identification products applicable to project.
   2.  Submit two nameplates, 4 x 4 inch (100 x 100 mm) in size illustrating materials
      and engraving quality.

D.  Manufacturer's Installation Instructions: Indicate installation instructions, special
    procedures, and installation.

1.03  CLOSEOUT SUBMITTALS

A.  See Division 1 Execution and Closeout Requirements: Requirements for submittals.

B.  Project Record Documents: Record actual locations of tagged devices; include tag
    numbers.

1.04  QUALIFICATIONS

A.  Manufacturer: Company specializing in manufacturing Products specified in this section
    with minimum three years documented experience.

B.  Installer: Company specializing in performing Work of this section with minimum three
    years documented experience approved by manufacturer.
1.05 DELIVERY, STORAGE, AND HANDLING

A. See Division 1 Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept identification products on site in original containers. Inspect for damage.

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

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

1.06 ENVIRONMENTAL REQUIREMENTS

A. See Division 1 Product Requirements: Environmental conditions affecting products on site.

B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.

B. Letter Size:
   1. 1/8 inch high letters for identifying individual equipment and loads.
   2. 1/4 inch high letters for identifying grouped equipment and loads.

C. Minimum nameplate thickness: 1/8 inch.

2.02 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.03 WIRE MARKERS

A. Description: Split sleeve or tubing type wire markers.

B. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
   2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams and shop drawings.

2.04 CONDUIT AND RACEWAY MARKERS

A. Description: Colored tape or paint to identify conduit by system. Adhesive label to identify conduit by voltage, width of color band to be minimum of 1” wide.
   1. Medium Voltage System: Black lettering on white background.
   2. 480 Volt System: Black lettering on white background.
   3. 208 Volt System: Black lettering on white background.
11. Category 5 Cable: Light Green.
12. Fiber Optic Cable: Dark Green.

B. Legend:
   1. Medium Voltage System: HIGH VOLTAGE 4160/2400V.
   2. 480 Volt System: 480 VOLTS. HIGH VOLTAGE.
   3. 208 Volt System: 208 VOLTS.

2.05 UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.06 LOCKOUT DEVICES

A. Lockout Hasps:
   1. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches (184 x 75 mm).

PART 3 EXECUTION

3.01 PREPARATION

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

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 EXISTING WORK

A. Install identification on existing equipment to remain in accordance with this section.

B. Install identification on unmarked existing equipment.

C. Replace lost nameplates and labels.

D. Re-label existing equipment.

E. Paint conduits to identify system.

3.03 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, do not use adhesive.
   3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
   4. Secure nameplate to equipment front using screws or rivets.
   5. Secure nameplate to inside surface of door on recessed panelboard in finished locations with adhesive.
6. Install nameplates for the following:
   a. Switchboards.
   b. Panelboards.
   c. Transformers.
   d. Disconnects.

C. Label Installation:
   1. Install label parallel to equipment lines.
   2. Install label for identification of individual control device stations, receptacles and data outlets.
      a. Labels shall include where equipment is fed from.
   3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
   2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   3. Install labels at data outlets identifying patch panel and port designation.

E. Raceway Marker Installation:
   1. Install raceway marker for each raceway longer than 6 feet.
   2. Raceway Marker Spacing: 50 feet on center.
   3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
      a. Paint [colored band on] each conduit longer than 6 feet.
      b. Paint bands 50 feet on center.

F. Underground Warning Tape Installation:
   1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable and at 6 inches above conduit when installed deeper than 24 inches.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes short circuit and protective device coordination study encompassing portions of electrical distribution system from normal power source or sources up to and including breakers in service entrance switchboard, fuses in service entrance switchboard, main breaker in sub-distribution panels, fuses in sub-distribution panels and main breaker in each panelboard and largest downstream device from each panel.

B. Related Sections:
   2. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.
   3. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
   4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   5. Section 26 22 00 - Low-Voltage Transformers.
   7. Section 26 24 16 - Panelboards.
   8. Section 26 25 00 - Enclosed Bus Assemblies.
   9. Section 26 28 13 - Fuses.
   10. Section 26 28 19 - Enclosed Switches.
   12. Section 26 29 13 - Enclosed Controllers.
   13. Section 26 29 16 - Enclosed Contactors.

1.02  REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.03  DESIGN REQUIREMENTS

A. Complete Short Circuit and Protective Device Coordination Study and ARC flash fault hazard study to meet requirements of NFPA 70, 70E, and 99, IEEE STD 1584a and 399, and ANSI C.37.

B. Report Preparation:
   1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
   2. Perform study with aid of computer software program.
   3. Obtain actual settings for packaged chiller and motor characteristics for equipment incorporated into Work.
   4. Calculate short circuit interrupting and, when applicable, arc flash hazards, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
      a. Utility supply bus.
      b. Medium voltage air interrupter switchgear.
      c. Medium voltage circuit breaker switchgear.
      d. Secondary unit substations.
e. Automatic transfer switch.
g. Engine generator.
h. Medium voltage motor controllers.
i. Medium voltage oil switchgear.
j. Low-voltage switchgear.
k. Switchboards.
l. Motor control centers.
m. Distribution panelboards.
n. Branch circuit panelboards.
o. Busway.
p. Each other significant equipment location throughout system.

5. Arc Flash Hazard Analysis:
   a. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
   b. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
   c. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
   d. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
   e. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
   f. The Arc-Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
   g. Arc Flash computation shall include both line and load side of main breaker calculations, where necessary.
   h. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

C. Report Contents:
1. Include the following:
   a. Calculation methods and assumptions.
   b. Base per unit value selected.
   c. One-line diagram.
   d. Source impedance data including power company system available power and characteristics.
   e. Typical calculations.
      1) Fault impedance.
      2) X to R ratios.
      3) Asymmetry factors.
      4) Motor fault contribution.
      5) Short circuit kVA.
      6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
      7) Tabulations of calculation quantities and results.
      8) Arc Flash fault hazard values.
f. One-line diagram revised by adding actual instantaneous short circuits available.
g. State conclusions and recommendations.

2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.

3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.

4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
a. Power company relay characteristics.
b. Power company fuse characteristics.
c. Medium voltage equipment protective relay characteristics.
d. Medium voltage equipment protective fuse characteristics.
e. Low voltage equipment circuit breaker trip device characteristics.
f. Low voltage equipment fuse characteristics.
g. Cable damage point characteristics.
h. Pertinent transformer characteristics including:
   1) Transformer full load current.
   2) Transformer magnetizing inrush.
   3) ANSI transformer withstand parameters.
   4) Significant symmetrical fault current.
i. Pertinent motor characteristics.
j. Generator characteristics including:
   1) Phase and ground coordination of generator protective devices.
   2) Decrement curve and damage curve.
   3) Operating characteristic of protective devices.
   4) Actual impedance value.
   5) Time constants.
   6) Current boost data.
   7) Do not use typical values for generator.
k. Transfer switch characteristics.
l. Other system load protective device characteristics.

6. Incident Energy and Flash Protection Boundary Calculations:
a. Arcing fault magnitude.
b. Device clearing time.
c. Duration of arc.
d. Arc flash boundary.
e. Working distance.
f. Incident energy.
g. Hazard risk category.
h. Recommendations for arc flash energy reduction.

1.04 SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Qualifications Data: Submit the following for review prior to starting study.
1. Submit qualifications and background of firm.
2. Submit qualifications of Professional Engineer performing study.

C. Software: Submit for review information on software proposed to be used in performing study.
D. Product Data: Submit the following:
1. Report: Summarize results of study in report format including the following:
   a. Descriptions, purpose, basis, and scope of study.
   b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
   c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
   d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
   e. Arc flash fault hazard values with labels for applying to equipment.

E. Submit copies of preliminary report using approximate feeder lengths signed by professional engineer. Make additions or changes required by review comments.

F. Submit final report at end of project construction, prior to Part 3.2 Adjustments. Report shall be revised as required to reflect true field conductor lengths and any modification report shall be signed by professional engineer.

1.05 QUALITY ASSURANCE
A. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of 3 years documented availability.
B. Perform study in accordance with IEEE 242 and IEEE 1584a.

1.06 QUALIFICATIONS
A. Study Preparer: Company specializing in performing work of this section with minimum 3 years documented experience and having completed projects of similar size and complexity within the past 3 years.
B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Nevada with minimum of five years experience in power system analysis.
C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.07 PRE-INSTALLATION MEETINGS
A. See Division 1 Administrative Requirements: Pre-installation meeting.
B. Convene minimum one week prior to commencing work of this section.

1.08 SEQUENCING
A. See Division 1 Summary: Requirements for sequencing.
B. Complete study within 4 weeks after pre-installation meeting.
C. Allow for review of completed study by Engineer.
D. Submit short circuit and protective device coordination study to Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.

E. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.09 SCHEDULING

A. See Division 1 Administrative Requirements and Construction Progress Schedule: Requirements for scheduling.

B. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.10 COORDINATION

A. See Division 1 Administrative Requirements: Requirements for coordination.

B. Coordinate work with local power company.

PART 2 PRODUCTS - Not used.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. See Division 1 Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.

C. Select each primary protective device for delta-wye connected transformer so device’s characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.

D. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

E. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

3.02 ADJUSTING

A. See Division 1 Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.
C. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

D. Notify Owner in writing of any required major equipment modifications.

3.03 ARC FLASH WARNING LABELS

A. The vendor shall provide a 3.5 inch x 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:
   1. Location designation.
   2. Nominal voltage.
   3. Flash protection boundary.
   5. Incident energy.
   7. Engineering report number, revision number and issue date.

C. Labels shall be machine printed, with no field markings.

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
   1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided.
   2. For each motor control center, one arc flash label shall be provided.
   3. For each low voltage switchboard, one arc flash label shall be provided.
   4. For each switchgear, one flash label shall be provided.
   5. For medium voltage switches, one arc flash label shall be provided.

E. Label shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.04 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energizes equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section Includes:
1.  Remote control lighting relays.
2.  Lighting contactors.
4.  Switch plates.
5.  Occupancy sensors.
6.  Photocells.
7.  Photocell control unit.

B.  Related Sections:
1.  Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
2.  Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
3.  Section 26 05 33 - Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.
4.  Section 26 05 53 - Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.
5.  Section 26 24 16 - Panelboards.
6.  Section 26 27 26 - Wiring Devices: Product requirements for wiring devices for placement by this section.

1.02  REFERENCES

A.  National Electrical Manufacturers Association:
1.  NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2.  NEMA FU 1 - Low Voltage Cartridge Fuses.
3.  NEMA ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4.  NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.
5.  NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
6.  NEMA ICS 6 - Industrial Control and Systems: Enclosures.
7.  NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.03  SYSTEM DESCRIPTION

A.  Distributed switching control using self contained individually mounted lighting relays.

B.  Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting inside building larger than 5000 square feet (465 square meters). Control shutoff by method conforming to ICC IECC.

C.  Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting outside building. Control shutoff by method conforming to ICC IECC.
1.04 SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
   1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
   2. Include typical wiring diagrams for each component.

C. Product Data: Submit manufacturer's standard product data for each system component.

D. Manufacturer's Installation Instructions: Submit for each system component.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

A. See Division 1 Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record the following information:
   1. Actual locations of components and record circuiting and switching arrangements.
   2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.

C. Operation and Maintenance Data:
   1. Submit replacement parts numbers.
   2. Submit manufacturer's published installation instructions and operating instructions.
   3. Recommended renewal parts list.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Division 1 Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept components on site in manufacturer's packaging. Inspect for damage.

C. Protect components by storing in manufacturer's containers indoor protected from weather.

1.08 WARRANTY

A. See Division 1 Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five year manufacturer warranty for components.

1.09 EXTRA MATERIALS

A. See Division 1 Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two of each switch type.
C. Furnish two of each occupancy sensor type.

D. Furnish two of each photocell type.

PART 2 PRODUCTS

2.01 REMOTE CONTROL LIGHTING RELAYS

A. Manufacturers:
   1. Acuity Branch.
   2. Cooper.
   4. Square D.
   5. General Electric.
   6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Heavy duty, single-coil momentary contact mechanically held remote control relays.

C. Contacts: Rated 20 amperes at 277 volts. Rated for lighting applications with LED, high intensity discharge (HID), quartz halogen, tungsten, and fluorescent lamps.

D. Line Voltage Connections: Clamp type screw terminals.

E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 4.

2.02 LIGHTING CONTACTORS

A. Manufacturers:
   1. Automatic Switch Co.
   3. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Mechanically held, 2 wire control.

D. Coil Operating Voltage: 120 volts, 60 Hertz.

E. Poles: To match circuit configuration and control function.

F. Contact Rating: Conductor overcurrent protection, considering derating for continuous loads.

G. Accessories:
   1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
   2. Pushbutton: ON/OFF function, with shrouded configuration.
   3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
   4. Indicating Light: Red lens, transformer type, with led lamp.
5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
7. Control Power Transformers: 120 volt secondary, 120 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

H. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4.

2.03 SWITCHES

A. Manufacturers:
1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour/Legrand.
4. Substitutions: See Division for Product Requirements and Substitution Procedures.

B. Wall Switch: Specification Grade, momentary pushbutton type for overriding relays.

C. Key Switch: Spade key type. Match non-key switch ratings.

D. Switches with Pilot Lamp: Momentary contact, three position rocker type, white color, rated 3 amperes at 25 VAC, with integral red pilot light.

2.04 SWITCH PLATES

A. Manufacturers:
1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour/Legrand.
4. Substitutions: See Division for Product Requirements and Substitution Procedures.

B. Product Description: Specification Grade.

2.05 OCCUPANCY SENSOR

A. Manufacturers:
3. Watt Stopper Model DT-300.
4. Substitutions: See Division for Product Requirements and Substitution Procedures.

B. Compatible with modular relay panels. Capable of being wired directly to Class 2 wiring without auxiliary components or devices.

C. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 12 minutes.

D. Furnish with manual override.
E. Operation: Silent.

F. Room Sensors: As indicated on Drawings.

G. Corridor and Hallway Sensors:
   1. Capable of detecting motion 14 feet (4 m) wide and 80 feet (24 m) long with one sensor mounted 10 feet (3 m) above floor.
   2. Capable of detecting motion in warehouse aisle 10 feet (3 m) wide and 60 feet (18 m) long or 100 feet (30 m) long when mounted 22 feet (7 m) above floor.
   3. Capable of being wired in master-slave configuration to extend area of coverage.

H. Description: Dual technology sensor, using passive infrared and ultrasonic or microphonic technology, ceiling mount occupancy sensor.

I. Sensor shall have up to 2000 square feet coverage.

J. The ultrasonic frequency shall be minimum of 32 kHZ.

K. Provide with temperature and humidity resistant receivers and a LED indicator.

L. Provide with power pack and/or slave pack as required.

M. Adjusting: Contractor to adjust all sensors as follows:
   1. PIR and Ultrasonic detection required to turn “on” lights.
   2. No occupancy time delay at 10 minutes.
   3. PIR and Ultrasonic sensitivity to be set so that lights turn-on before occupant proceeds more than 5 feet into room.
   4. Contractor to set and test all motion sensors 30 days prior to substantial completion.
   5. Contractor to cooperate with commissioning agent to test and verify sensor settings are as specified.

2.06 PHOTOCELLS

A. Manufacturers:
   1. Douglas Lighting Controls.
   2. MYTECH Corporation.
   4. Watt Stopper.
   5. Substitutions: See Division for Product Requirements and Substitution Procedures.

B. General: Consist of sensor mounted with separate control-calibration module. Sensor connected to control-calibration module via single shielded conductor with maximum distance of 500 feet (150 m). Control unit powered by 24 VAC.

C. Control-Calibration Module: Furnish with the following:
   1. Capable of being switched between 4 measurement ranges.
   2. Separate trip points for high and low response settings.
   3. Momentary contact device to override photocell relays.
   4. Three minute time delay between switching outputs to avoid nuisance tripping.

D. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.
   1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-10 footcandles in 10 percent increments. Entire sensor encased in optically clear epoxy resin.
   2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 100-1,000 footcandles (1,076-10,760 lx).
4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 1,000-10,000 footcandles (10,760-107,640 lx).

2.07 PHOTOCCELL CONTROL UNIT

A. Manufacturers:
   1. Douglas Lighting Controls.
   2. MYTECH Corporation Model.
   4. Watt Stopper.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: Photodiode control unit with PHOTOCELL ENABLE and MASTER OVERRIDE inputs for remote control, 3 minute time delay, and with selectable ranges for 1-10 footcandle (11-108 lx) for exterior pathway and, 10-100 footcandle for interior and balcony (108-1,076 lx).

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount switches, occupancy sensors, and photocells as indicated on Drawings.
B. Install wiring in accordance with Section 26 05 19.
C. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings. Install wire in conduit in accordance with Section 26 05 33.
D. Label each low voltage wire clearly indicating connecting relay panel. Refer to Section 26 05 53.
E. Mount relay as indicated on Drawings. Wire numbered relays in panel to control power to each load. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.
F. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
G. Label each low voltage wire with relay number at each switch or sensor.

3.02 MANUFACTURER’S FIELD SERVICES

A. See Division 1 Quality Requirements: Requirements for manufacturer’s field services.
B. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:
   1. Check installation of panelboards.
   2. Test operation of remote controlled devices.
   3. Repair or replace defective components.
3.03 ADJUSTING

A. See Division 1 Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Test each system component after installation to verify proper operation.

C. Test relays, contactors, and switches after installation to confirm proper operation.

D. Confirm correct loads are recorded on directory card in each panel.

3.04 DEMONSTRATION

A. See Division 1 Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate operation of the following system components:
   1. Operation of switches. Demonstrate for all zones.
   2. Operation of each type of occupancy sensors. Demonstrate for all zones.
   3. Operation of each type of photocell. Demonstrate for all zones.

C. Furnish 4 hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least 7 days notice to Owner and Engineer of training date.

END OF SECTION
SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes branch circuit panelboards.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
   2. NEMA FU 1 - Low Voltage Cartridge Fuses.
   3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   6. NEMA PB 1 - Panelboards.
   7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1283 - Electromagnetic Interference Filters.
   3. UL 1449 - Transient Voltage Surge Suppressors.

1.03 SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement, sizes, and accessories.

C. Product Data: Submit catalog data showing specified features of standard products.
1.04 CLOSEOUT SUBMITTALS

A. See Division 1 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 MAINTENANCE MATERIALS

A. See Division 1 - Execution and Closeout Requirements: Requirements for maintenance products.

B. Furnish two of each panelboard key. Panelboards keyed alike.

PART 2 PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:
   1. Cutler Hammer.
   2. General Electric.
   3. Siemens.
   4. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current-carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.

D. Minimum Integrated Short Circuit Rating: 22,000 amperes rms symmetrical for 280 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

F. Enclosure: NEMA PB 1, Type 1.

H. Cabinet Front: Front with Door-in-door cover, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
1. Provide mounting (flush or surface) as indicated on drawings.

I. Integral Surge Suppressor:
1. Component recognized in accordance with UL 1449 and UL 1283.
2. Independently tested with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.
3. Furnish copper bus bars for surge current path.
4. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
5. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
6. Meet or exceed the following criteria:
   a. Maximum single impulse current rating not less than 120 kA for each phase.
   b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
   c. Clamping voltage not exceeding the following:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>L-N</th>
<th>N-G</th>
<th>L-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>500 V</td>
<td>500 V</td>
<td>500 V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1000 V</td>
<td>1000 V</td>
<td>1000 V</td>
</tr>
</tbody>
</table>

7. Furnish response time no greater than five nanoseconds for individual protection modes.
8. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
10. Furnish minimum EFI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50:1 using Mil Std. 220A methodology.

PART 3 EXECUTION

3.01 EXISTING WORK

A. Disconnect abandoned panelboards. Remove abandoned panelboards.
B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.
C. Clean and repair existing panelboards to remain or to be reinstalled.

3.02 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.
B. Install panelboards plumb.
C. Install recessed panelboards flush with wall finishes.
D. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

G. Install engraved plastic nameplates in accordance with Section 26 05 53.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 3 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.04 ADJUSTING

A. See Division 1 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION
SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1  GENERAL

1.01  SUMMARY

A.  Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

B.  Related Sections:
1.  Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2.  Section 26 05 33 - Raceway and Boxes for Electrical Systems.
3.  Section 27 05 33 - Conduits and Backboxes for Communications Systems.
4.  Section 28 05 33 - Conduits and Backboxes for Electronic Safety and Security.

1.02  REFERENCES

A.  National Electrical Manufacturers Association:
1.  NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2.  NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.03  SUBMITTALS

A.  See Division 1 Submittal for procedures.

B.  Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

C.  Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04  QUALIFICATIONS

A.  Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.05  EXTRA MATERIALS

A.  See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B.  Furnish two of each key.

PART 2  PRODUCTS

2.01  HINGED COVER ENCLOSURES

A.  Manufacturers:
1.  Carlon Electrical Products.
2.  Hubbell Wiring Devices.
5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Construction: NEMA 250, Type 4 steel enclosure.

C. Covers: Continuous hinge, held closed by hasp and staple for padlock.

D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

E. Enclosure Finish: Manufacturer’s standard gray enamel.

2.02 CABINETS

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Boxes: Galvanized steel.

C. Box Size: 24 inches wide x 30 inches high x 6 inches deep.


E. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

F. Knockouts: Manufacturer’s standard top and bottom.

G. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

H. Furnish accessory feet for free-standing equipment.

2.03 TERMINAL BLOCKS

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices.
   4. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.


C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Furnish ground bus terminal block, with each connector bonded to enclosure.
PART 3  EXECUTION

3.01  EXISTING WORK

A. Remove abandoned cabinets and enclosures, including abandoned cabinets and enclosures above accessible ceiling finishes. Patch surfaces.

B. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing cabinets and enclosures using materials and methods as specified.

D. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.02  INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.

B. Install cabinet fronts plumb.

3.03  CLEANING

A. See Division 1 - Execution and Closeout Requirements: Final cleaning.

B. Clean electrical parts to remove conductive and harmful materials.

C. Remove dirt and debris from enclosure.

D. Clean finishes and touch up damage.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A.  Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; occupancy sensors; device plates; decorative box covers.

B.  Related Sections:
   1.  Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.
   2.  Section 26 05 34 - Floor Boxes for Electrical Systems: Service fittings for receptacles installed on floor boxes.
   3.  Section 26 05 34 - Floor Boxes for Electrical Systems: Poke-through receptacles.

1.02  REFERENCES

A.  National Electrical Manufacturers Association:
   1.  NEMA WD 1 - General Requirements for Wiring Devices.
   2.  NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03  SUBMITTALS

A.  See Division 1 for Submittal Procedures.

B.  Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

C.  Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.04  QUALIFICATIONS

A.  Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.05  EXTRA MATERIALS

A.  See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B.  Furnish two of each style, size, and finish for wall plate, switch, and receptacle.

1.06  QUALITY ASSURANCE

A.  Requirements of Regulatory Agencies:
   1.  IEEE Compliance:
   2.  Underwriters’ Laboratories, Inc. (UL):
       a.  UL 20, 486A, 498, 508 and 943.
B. Reference Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. NEMA Standards Publication / No. WD 1, WD 2, WD 5.
   2. National Electrical Contractors Association (NECA):
      a. NECA – Standard of Installation.

C. Material and equipment shall be new and conform to grade, quality and standards specified. Equipment or materials of the same type shall be the product of same manufacturer throughout.

D. The manufacturer’s catalog numbers specified represent the minimum standards required. If products of alternative manufacturers are selected from the approved manufacturer’s list, they must be equal to or exceed the standards and performance criteria set forth.

E. All supplied wiring devices shall be by a single manufacturer.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

1. Cooper
2. Hubbell Inc.
3. Leviton.
4. Pass and Seymour.

2.02 GENERAL

A. Provide factory-fabricated wiring devices in type, color, and electrical rating for service indicated.

B. See Symbol Schedule on drawings for identification of device type.

2.03 DEVICE COLORS

A. Devices circuited from normal power panels shall be White in color.

B. Devices circuited from emergency power panels shall be red in color.

2.04 GENERAL

A. Terminal screws shall be back and side wired and accept #14, 12, and #10 AWG stranded or solid wire.

B. A full wrap-around bridge strap shall be provided with locking tabs to secure receptacle face.

C. Receptacle face shall be impact resistant nylon.
A. Heavy-Duty, Simplex:
   1. Provide single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 amperes, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
      a. Cooper - 5361
      b. Pass & Seymour – 5361
      c. Hubbell – HBL5361
      d. Leviton - 5361

B. Heavy-Duty Duplex:
   1. Provide heavy duty duplex receptacles, 2 pole, 3 wire, grounding, 20 amperes, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
      a. Cooper 5362
      b. Pass & Seymour – 5362A
      c. Hubbell – HBL5362
      d. Leviton – 5362A
   2. Tamper resistant safety type receptacles shall be:
      a. Cooper – TR6350

C. Ground-Fault Circuit Interrupters:
   1. Provide ground fault circuit interrupter, with heavy duty duplex receptacles, capable of being installed in a 2-1/2 inch deep outlet box without adapter. Shall be grounding type UL-rated Class A, Group 1, rated 20 amperes, 120 volts, 60 Hz; with solid-state ground fault sensing and signaling; with 5 milliampere ground fault trip level. Equip with NEMA configuration 5-20 receptacle.
      a. Test and reset buttons shall match color of face.
      b. GFCI receptacles shall meet 2006 UL requirements.
      c. If critical components within receptacle are damaged and the ground fault protection is lost, power to receptacle shall be automatically disconnected within the device.
         1) Pass & Seymour – 2094
         2) Hubbell – GFR5352
         3) Leviton – 8899
   2. GFCI type tamper resistant safety type receptacles shall be:
      a. Cooper TRVGFx (xx denotes Amperage size; either 15 or 20 to match breaker size)

D. Duplex Convenience Isolated Ground Receptacles:
   1. Provide single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 amperes, 125 volts, with NEMA configuration 5-20R unless otherwise indicated.
      a. Device color shall match non isolated ground receptacles and have an orange triangle on the device.
         1) Cooper – IG5362
         2) Pass & Seymour – IG6300
         3) Hubbell – IG5362
         4) Leviton – 5362IG
2.06 SWITCHES

A. General:
1. Switches shall be rated for 20 amperes, 120/277 volts AC, and shall be manufacturer’s specification grade toggle switch with thermoplastic abuse resistant toggle, quiet action, and heavy duty contact arm.
2. Switches shall have quiet action mechanism with silver alloy contacts for longevity.
3. Terminal screws shall be back and side wire and accept #14, 12, and 10 AWG stranded or solid wire.
4. Switches shall have a backwire pressure plate ground screw mechanism accepting #14, 12, and 10 AWG stranded or solid wire.

B. Single Pole:
1. Cooper - 2221
2. Pass & Seymour – PS20AC1
3. Hubbell – HBL1221
4. Leviton – 1221-2

C. Double Pole Single Throw:
1. Cooper - 2222
2. Pass & Seymour – PS20AC2
3. Hubbell – HBL1222
4. Leviton – 1222-2

D. Three Way:
1. Cooper - 2223
2. Pass & Seymour – PS20AC3
3. Hubbell – HBL1223
4. Leviton – 1223-2

E. Four Way:
1. Cooper - 2224
2. Pass & Seymour – PS20AC4
3. Hubbell – HBL1224
4. Leviton – 1224-2

F. Key Switch – add suffix ‘KL’ to above part numbers.

G. Momentary Contact:
1. Cooper - 1995
2. Pass & Seymour – 1251
3. Hubbell – HBL1557
4. Leviton – 1257

2.07 DIMMERS – WALL BOX

A. LED:
1. Provide dimmers suitable for driver.

B. Fluorescent Lamp:
1. Provide single pole, full-wave semi-conductor modular type AC dimmers for fluorescent fixtures; with 60 Hz, wattage and voltage as indicated, and with electromagnetic filters to reduce noise, RF and TV interference to minimum. Construct with continuously adjustable trim potentiometer for adjustment of low and dimming; and with anodized heat sinks. Provide 6 inch wire connecting leads.
   a. Lutron type NTHF series or equal (slide to off).
2.08 WIRING DEVICE ACCESSORIES

A. Wall Plates:
   1. Provide wall plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:
      a. Material and Finish:
         1) Stainless Steel (0.04 inch thick type 302 satin finished).
         2) Nylon, smooth – color to match device.
   2. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel covers.
   3. Device plates for surface mounted, 4 in. square boxes: ½ in. raised galvanized steel covers.

B. Weatherproof Covers:
   1. Weatherproof covers for all 125-250 volt, 15 and 20 amperes receptacles installed outdoors in a wet location shall be weatherproof, NEMA 3R, with hinged outlet enclosure rated for rain proof protection while outlet is in use. The unit shall be furnished with a neoprene gasket between the mounting surface and the enclosure, and between the mounting plate and the hinged cover to assure proper seal.
      a. Public Spaces
         1) Shall be equal to:
            a) Tay Mac - ML400G.
               (1) Available for use in building walls and standalone installations.
            b) Intermatic – WP1000RC.
               (1) Only use for flush mounting in building walls.
            c) Pass & Seymour – WIUFC10S.
               (1) Only available for flush mounting in non-CMU walls
      b. Non-Public Spaces
         1) Shall be equal to:
            a) Intermatic, Die Cast with GFI mounting plate, horizontal mount (duplex), Catalog #WP1010HMC, vertical mount (quad), Catalog #WP1030MC.

   2. Weatherproof covers for all other receptacles shall be cast aluminum with a gasketed cover. Shall be equal to Hubbell CWP26H (standard flush box) or Hubbell WPFS26 (surface FS box).

2.09 OCCUPANCY SENSORS

A. Manufacturers:
   4. Substitutions permitted under provisions of Section 01630.

B. Description: Dual technology sensor, using passive infrared and ultrasonic or microphonic technology, ceiling mount occupancy sensor.

C. Sensor shall have up to 2000 sq./ft. coverage.

D. The ultrasonic frequency shall be minimum of 32 kHZ.

E. Provide with temperature and humidity resistant receivers and a LED indicator.
F. The sensor shall have an adjustable time-delay of 30 seconds to 15 minutes.

G. Provide with power pack and/or slave pack as required.

H. Adjusting: Contractor to adjust all sensors as follows:
   1. PIR and Ultrasonic detection required to turn “on” lights.
   2. No occupancy time delay at 10 minutes.
   3. PIR and Ultrasonic sensitivity to be set so that lights turn-on before occupant proceeds more than 5 feet into room.
   4. Contractor to set and test all motion sensors 30 days prior to substantial completion.
   5. Contractor to cooperate with commissioning agent to test and verify sensor settings are as specified.

PART 3 EXECUTION

3.01 EXAMINATION
   A. See Division 1 - Administrative Requirements: Coordination and project conditions.
   B. Verify outlet boxes are installed at proper height.
   C. Verify wall openings are neatly cut and completely covered by wall plates.
   D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION
   A. Clean debris from outlet boxes.

3.03 EXISTING WORK
   A. Disconnect and remove abandoned wiring devices.
   B. Modify installation to maintain access to existing wiring devices to remain active.
   C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.04 INSTALLATION
   A. Install devices plumb and level. Do not install devices until wiring is complete. Clean electrical boxes of dirt and debris.
   B. Install switches with OFF position down.
   C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
   D. Do not share neutral conductor on load side of dimmers.
   E. Install receptacles with grounding pole on bottom.
   F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor. Isolated ground receptacles shall have the second ground wire (green with yellow tracer) ground the receptacle.
G. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Do not install until after painting is complete.

H. Do not use terminals on wiring devices (hot or neutral) for feed thru connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.

I. Use jumbo size plates for outlets installed in masonry walls.

J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

K. Install in accordance with manufacturer’s written instructions, applicable requirements of NEC and NECA’s “Standard of Installation” and in accordance with recognized industry practices.

L. Mount switches and receptacles in vertical position in building interiors.

M. All exterior receptacles shall be GFI type mounted in weatherproof boxes.

3.05 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor.

D. Install convenience receptacle 6 inches above back splash of counter.

E. Install dimmer 48 inches above finished floor.

F. Coordinate installation of wiring devices with under floor raceway service fittings provided under Section 26 05 39.

G. Coordinate installation of wiring devices with floor box service fittings provided under Section 26 05 34.

H. Mount receptacles with weatherproof plates in horizontal position.

I. Install gasket plates for devices or system components having light emitting features, such as switch with pilot light and dome lights. Where installed on rough textured surfaces, seal with black self adhesive poly-foam.

J. This Contractor shall check the switch location against the Architectural plans and shop drawings to be certain that switches are on the strike side of the door, regardless of swing shown on drawings. Edge of plate shall be not more than 12” from door frame.

K. Install emergency switches which occur adjacent to normal light switches in separate boxes to maintain system’s isolation in accordance with NEC required separation.

L. Provide wiring device cover plates identifying device circuit numbers as outlined in specification 26 05 53.

M. Ground-fault circuit interrupter type receptacles may provide GFI protection for downstream receptacles on same circuit only where located in same room as other receptacles.
3.06 FIELD QUALITY CONTROL
   A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
   B. Inspect each wiring device for defects.
   C. Operate each wall switch with circuit energized and verify proper operation.
   D. Verify each receptacle device is energized.
   E. Test each receptacle with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults.
   F. Test each GFCI receptacle device for proper operation.
   G. Provide a grounding system test in accordance with NFPA 99 for all receptacles in patient care areas.

3.07 ADJUSTING
   A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
   B. Adjust devices and wall plates to be flush and level.

3.08 CLEANING
   A. See Division 1 - Execution and Closeout Requirements: Final cleaning.
   B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes fuses and spare fuse cabinet.

1.02  REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.03  DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for
   the following components: wire, cable, bus structures, and other equipment. Design
   system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective
   elements, including other fuses, circuit breakers, and protective relays. Design system to
   maintain operation of device closest to fault operates.

1.04  FUSE PERFORMANCE REQUIREMENTS

A. Main Service Switches Larger than 600 amperes: Class L (time delay), Class T.

B. Main Service Switches: Class RK1 (time delay), RK5 (time delay).

C. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).

D. Power Load Feeder Switches: Class RK1 (time delay), RK5.

E. Motor Load Feeder Switches: Class RK1 (time delay), RK5, J (time delay).

F. Lighting Load Feeder Switches Larger than 600 amperes: Class L (time delay).

G. Lighting Load Feeder Switches: Class RK1 (time delay), RK5, J (time delay).

H. Other Feeder Switches Larger than 600 amperes: Class L (time delay).

I. Other Feeder Switches: Class RK1 (time delay), RK5, J (time delay).

J. General Purpose Branch Circuits: Class RK1 (time delay), RK5, J (time delay).

K. Motor Branch Circuits: Class RK1 (time delay), RK5.

L. Lighting Branch Circuits: Class G.

1.05  SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Product Data: Submit data sheets showing electrical characteristics, including time-
current curves.
1.06 CLOSEOUT SUBMITTALS
   A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.
   B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.07 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.08 MAINTENANCE MATERIALS
   A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.
   B. Furnish two fuse pullers.

1.09 EXTRA MATERIALS
   A. See Division 1 - Execution and Closeout Requirements: Requirements for extra materials.
   B. Furnish three spare fuses of each Class, size, and rating installed.

PART 2 PRODUCTS

2.01 FUSES
   A. Manufacturers:
      1. Buss Mann Division; McGraw – Edison Company.
      2. General Electric Company.
      5. Littlefuse, Inc.
      6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
   B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
   C. Voltage: Rating suitable for circuit phase-to-phase voltage.
   D. Provide fuses of types, sizes, ratings, and average time / current and peak let-through current characteristics, indicated, which comply with manufacturer's standard design, materials, and construction in accordance with published product information, and with industry standards and configurations.
   E. Class CC Fast Acting Fuses:
      1. Provide UL Class CC fast acting fuses rated 600 V, 60 Hz, 1/10 to 30 amperes with 200,000 RMS symmetrical interrupting current rating for protecting motor control circuits, lighting ballasts, and control transformers.
   F. Class RK1 Time Delay Fuses:
      1. Provide UL Class RK1 time delay fuses rated 250 or 600 V, 60 Hz, up to 600 amperes, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers.
G. Class RK5 Time Delay Fuses:
   1. Provide UL Class RK5 time delay fuses rated 250 or 600 V, 60 Hz, up to 600 amperes, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

2.02 SPARE FUSE CABINET
   A. Product Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
   B. Doors: Hinged, with hasp for Owner’s padlock.
   C. Finish: Gray enamel.

PART 3 EXECUTION
3.01 EXISTING WORK
   A. Remove fuses from abandoned circuits.
   B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

3.02 INSTALLATION
   A. Install fuse with label oriented so manufacturer, type, and size are easily read.
   B. Install spare fuse cabinet as indicated on Drawings.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes fusible and nonfusible switches.

B. Related Sections:
   1. Section 26 28 13 - Fuses.

1.02  REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1.03  SUBMITTALS

A. See Division 1 for Submittal Procedures.

B. Product Data: Submit switch ratings and enclosure dimensions.

1.04  CLOSEOUT SUBMITTALS

A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.05  QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2  PRODUCTS

2.01  FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. GE Electric.
   2. Siemens.
   3. Cutler Hammer.
   4. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

E. Furnish switches with entirely copper current carrying parts.

2.02 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. GE Electric.
   2. Siemens.
   3. Cutler Hammer.
   4. Square D.
   5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B. Product Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

D. Furnish switches with entirely copper current carrying parts.

2.03 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

PART 3 EXECUTION

3.01 EXISTING WORK

A. Disconnect and remove abandoned enclosed switches.

B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.02 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet (1500 mm) to operating handle.

C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
D. Install engraved plastic nameplates in accordance with Section 26 05 53.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed. Indicate circuit number of circuit serving disconnect.

F. Install in accordance with manufacturer’s written instructions, applicable requirements of NEC and NECA’s “Standard of Installation” and in accordance with recognized industry practices.

G. Locate disconnect switches as shown or called out on drawings and as required by NEC.

H. Provide control circuit interlock as required by NEC.

3.03 FIELD QUALITY CONTROL

A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.04 ADJUSTMENT

A. Adjust covers and operating mechanism for free mechanical movement.

B. Verify overcurrent protection to provide proper operation and compliance with NEC.

C. Tighten wire and cable connections.

D. Clean interior of enclosure.

E. Touch up paint scratched or marred surfaces to match original finish.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Section includes enclosed contactors for lighting and general purposes.

B. Related Sections:
   1. Section 26 28 13 - Fuses.

1.02  REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

C. Underwriters Laboratories Inc:
   1. UL 489 - Molded Case Circuit Breakers and Molded Case Switches and Circuit-Breaker Enclosures.

1.03  SUBMITTALS

A. See Division 1 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit dimensions, size, voltage ratings and current ratings.

1.04  CLOSEOUT SUBMITTALS

A. See Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations and ratings of enclosed contactors.

C. Operation and Maintenance Data: Submit instructions for replacing and maintaining coil and contacts.

1.05  QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
PART 2  PRODUCTS

2.01  GENERAL PURPOSE CONTACTORS

A.  Manufacturers:
    1. Square D.
    2. General Electric.
    3. Cutler Hammer.
    4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B.  Product Description: NEMA ICS 2, AC general purpose magnetic contactor.

C.  Coil operating voltage: 120 volts, 60 Hertz.

D.  Poles: To match circuit configuration and control function.

E.  Product Features:
    1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
    2. Pushbutton: ON/OFF function, with shrouded configuration.
    3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
    4. Indicating Light: RED lens, transformer type, with neon lamp.
    5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
    7. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

F.  Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.

G.  Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
    1. Interior Dry Locations: Type 1.
    2. Exterior Locations: Type 3R.

2.02  LIGHTING CONTACTORS

A.  Manufacturers:
    1. General Electric.
    2. Square D
    3. Cutler Hammer.
    4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.

B.  Product Description: NEMA ICS 2, magnetic lighting contactor.

C.  Configuration: Mechanically held, 3 wire control.

D.  Coil operating voltage: 120 volts, 60 Hertz.

E.  Poles: To match circuit configuration and control function.

F.  Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
G. Accessories:
1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
2. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
3. Indicating Light: RED lens, transformer type, with led lamp.
4. Auxiliary Contacts: One field convertible in addition to seal-in contact.
5. Relays: NEMA ICS 2.
6. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

H. Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.

I. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 EXISTING WORK

A. Disconnect abandoned enclosed contactors and remove abandoned enclosed contactors.

B. Maintain access to existing enclosed contactors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing enclosed contactors to remain or to be reinstalled.

3.02 INSTALLATION

A. Install enclosed contactors in accordance with NECA "Standard of Installation."

B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 5 ft (1500 mm) to operating handle.

D. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.

E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

3.03 FIELD QUALITY CONTROL

A. See Division 1 - Quality Requirements Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION
SECTION 26 35 53

VOLTAGE REGULATORS (SURGE PROTECTIVE DEVICES (SPD’s))

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as distribution switchboards and panelboards.

1.02 RELATED SECTIONS

A. Section 26 24 13 – Switchboards.
B. Section 26 24 16 – Panelboards.

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.04 SUBMITTALS

A. The following information shall be submitted to the Engineer for each Device:
   1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL’s website or on any other NRTL’s website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).

B. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.

C. Test Reports:
   1. Indicate Let-Through voltage test data.
   2. Submit spectrum analysis of each unit.
   3. Submit test reports from nationally recognized independent testing laboratory verifying suppressors can survive published surge current rating

D. Manufacturer’s Installation Instructions: Submit installation instructions and connection requirements.

1.05 CLOSEOUT SUBMITTALS

A. The following information shall be submitted for record purposes:
   1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.
1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton
B. General Electric
C. Square D
D. Siemens

Use only equipment from the above manufacturers.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements
   1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
   2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
   3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOV) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>L-N</th>
<th>L-G</th>
<th>L-L</th>
<th>N-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wye</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Delta</td>
<td>N/A</td>
<td>●</td>
<td>●</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Split Phase</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>High Leg Delta</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.

6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
<th>600Y/347</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-N; L-G; N-G</td>
<td>700V</td>
<td>1200V</td>
<td>1500V</td>
</tr>
<tr>
<td>L-L</td>
<td>1200V</td>
<td>1800V</td>
<td>3000V</td>
</tr>
</tbody>
</table>

7. ANSI/IEEE C High Let-Through Voltage – The let-through voltage based on an ANSI/IEEE C62.41 Category C High waveform (10kV, 10kA) shall not exceed the following:

<table>
<thead>
<tr>
<th>Mode</th>
<th>208Y/120</th>
<th>480Y/277</th>
<th>600Y/347</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-N</td>
<td>500</td>
<td>900</td>
<td>1300</td>
</tr>
</tbody>
</table>

8. ANSI/IEEE Cat. B Ringwave Let Through Voltage – The let-through voltage based on an ANSI/IEEE C62.41 Category B ringwave (6 kV, 500 amps) shall not exceed the following:

<table>
<thead>
<tr>
<th>Mode</th>
<th>208Y/120</th>
<th>480Y/277</th>
<th>600Y/347</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-N</td>
<td>170</td>
<td>300</td>
<td>470</td>
</tr>
</tbody>
</table>
B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable to meet this specification shall not be accepted.

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
      1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
      2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
      3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
   b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
   c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter’s display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter’s memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection
   a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD’s components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements
   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.03 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution switchboard and panelboard location assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:
Minimum surge current capacity based on ANSI / IEEE C62.41 location category

<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Per Phase</th>
<th>Per Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)</td>
<td>250 kA</td>
<td>125 kA</td>
</tr>
<tr>
<td>B</td>
<td>High Exposure Roof Top Locations (Distribution Panelboards)</td>
<td>160 kA</td>
<td>80 kA</td>
</tr>
<tr>
<td>A</td>
<td>Branch Locations (Panelboards, MCCs, Busway)</td>
<td>120 kA</td>
<td>60 kA</td>
</tr>
</tbody>
</table>

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 DISTRIBUTION SWITCHBOARD AND PANELBOARD REQUIREMENTS

A. Panelboards
1. The SPD application covered under this section includes Panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category A environments.
2. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
3. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
4. The panelboard shall be capable of re-energizing upon removal of the SPD.
5. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
6. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
7. The SPD shall be of the same manufacturer as the panelboard.
8. The complete panelboard including the SPD shall be UL67 listed.

B. Distribution Switchboards
1. The SPD application covered under this section includes Distribution Switchboards. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchboard.
3. The SPD shall be factory installed inside the switchboard at the assembly point by the original equipment manufacturer.
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchboard as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.
2.05 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
   1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
   2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
   3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 1 – Administrative Requirements: Verification of existing conditions before starting work.

B. Verify mounting area is ready for equipment.

C. Verify circuit rough-ins are at correct location.

3.02 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.03 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION
SECTION 26 51 00
INTERIOR LIGHTING

PART 1  GENERAL

1.01  SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

B. Related Sections:
1. Section 09 58 00 - Integrated Ceiling Assemblies.
2. Section 23 37 00 - Air Outlets and Inlets: For interface with air handling fixtures.
3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
5. Section 26 52 00 - Emergency Lighting.

1.02  REFERENCES

A. American National Standards Institute:
2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
3. ANSI C78.379 – Electric Lamps – Incandescent and High-Intensity Discharge Reflector Lamps – Classification of Beam Patterns.
6. NEMA WD 6 – Wiring Devices-Dimensional Requirements.

B. Illuminating Engineering Society include:
2. LM-80-08: Measuring Lumen Maintenance of LED Light Sources
3. TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources.

1.03  SUBMITTALS

A. See Division 1 - Submittal Procedures: Submittal procedures.

B. Submit catalog literature for each fixture specified in booklet form with index and a separate sheet for each fixture, assembled in fixture “type” alphabetical order, with specified fixture manufacturer’s printed data. Each submittal shall clearly describe materials, type of diffuser, hardware, gasketing, reflector and chassis, finish, ballast and lamp to be used.

C. Contractor shall provide submittals for light fixtures as indicated in the Lighting Fixture Schedule. No substitutions are allowed. Where an alternate manufacturer is indicated for a specific fixture with no catalog number indicated for the alternate manufacturer, provide alternate fixture that is equal in all characteristics as the cataloged fixture.

D. Excessive delivery times shall not be an acceptable cause for substitution of specified fixtures. Notify Architect/Engineer of any long lead fixtures that may impact project schedule within two weeks of contract award. Beyond two weeks the contractor is responsible for any costs associated with expediting the manufacturing process of the specified fixture and/or cost associated with an approved substitute fixture if allowed by Architect/Engineer.
E. Submit ballast catalog data indicating lamp wattage, input watts, sound rating, power factor, ballast factor, and type of ballast for each similar fixture type.

F. Submit manufacturer’s printed data for lamps indicating lamp life, CRI, degrees Kelvin, etc. for each similar fixture type.

G. Submit photometric data if different than that specified and requested by Engineer.

H. Submit a sample fixture if different than that specified and requested by Engineer.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Fixtures as specified in “Lighting Fixture Schedule” establish a standard of quality for project as determined by Engineer.

C. Equivalency of fixtures is determined by Engineer and includes the following data for comparative purposes:
   1. Efficiency.
   2. Efficacy.
   3. Distribution.
   4. Construction.
   5. Design compatibility.
   6. Manufacturer reliability based upon past performances.

D. Fixtures shall conform to UL requirements and bear UL label and manufacturer’s name.

1.05 PRODUCT STORAGE AND HANDLING

A. Handle lighting fixtures carefully to prevent breakage, denting, and scoring finish.

B. Do not install damaged lighting fixtures.

C. Do not repair damaged fixtures; replace and return damaged units to equipment manufacturer for replacement.

D. Store lighting fixture in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

1.06 JOB CONDITIONS

A. Contractor shall determine that ceiling channel system is adequately supported to receive and support his lighting fixtures. Where deemed inadequate, do not install fixtures until additional support has been provided.

B. Verify local codes and ordinances that may pertain to fixture limitations, installation and aiming of exterior fixtures. Notify Engineer prior to Bid time if problems are encountered.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.
1.08 MAINTENANCE MATERIALS

A. See Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each plastic lens type.

C. Furnish six replacement lamps for each lamp type installed.

D. Furnish two of each ballast type.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein and listed in the Lighting Fixture Schedule.

2.02 LIGHTING FIXTURES

A. Provide lighting fixtures of the size, type, and rating indicated in “Lighting Fixture Schedule,” complete with, but not necessarily limited to, lamps, lampholders, reflectors, ballasts, starters, wiring and any other accessories required for a complete working installation.

B. Refer to Lighting Fixture Schedule on drawings.

C. Fixture catalog numbers do not necessarily include all accessories and are intended to serve as a guide in defining types and manufacturers of unit only.

D. Fixtures shall meet UL 1598 requirements. The appropriate UL label or listing will be acceptable as evidence of compliance with UL requirements.

E. The contractor shall ensure that the fixture is UL listed for the ambient conditions where installed. Extra compensation will not be permitted for failure to coordinate fixtures with their ambient conditions.
   1. Fixtures located exterior to the building and/or in unconditioned damp spaces and under cover from direct weather exposure shall be UL listed as “Suitable for Damp Locations” unless noted otherwise.
   2. Fixtures located exterior to the building and/or in unconditioned wet spaces and in direct contact with the weather or in washdown areas shall be UL listed as “Suitable for Wet Locations” unless noted otherwise.

F. Fixtures installed with direct contact with insulation shall have an ‘IC’ rating for direct contact with insulation. Verify if fixtures will be in contact with insulation prior to installation. Notify Architect/Engineer of any conflicts.

G. Gasketing material shall be vinyl or other non-aging type material as approved by Engineer.

H. Verify ceiling system compatibility with recessed fixture mounting before placing order.

I. Provide proper trim for each fixture as required for various types of ceiling being installed throughout project; plaster rings, fixture ends or caps, suspension units, mounting brackets, and/or other auxiliary parts necessary to make a complete fixture.
J. Comply with additional fixture requirements contained in "Remarks" on "Lighting Fixture Schedule" and "Notes" on drawings.

K. Provide fixture stems as indicated on drawings.

L. Where stems are furnished by fixture manufacturer, verify length prior to releasing for shipment.

M. Where stems are furnished by Contractor, verify length prior to installation.

N. Suspended fixtures shall have swivel type aligner hangers in ceiling outlet boxes to ensure plumb suspension.

O. Exit fixtures shall be installed so that line of sight is not obstructed.

P. Provide recessed fixtures with thermal protectors.

2.03 FLUORESCENT FIXTURES

A. Fabricate of sheet steel, die-formed to provide structural strength.

B. Treat fixtures for acceptance of baked white high reflectance enamel or porcelain enamel finish coat.

C. Color shall be as indicated on Lighting Fixture Schedule or as selected by Architect.

D. Lens panels for surface box type fixtures and for recessed troffers shall be framed and be equipped with hinge and latch. Equip frames and louvers with retaining means to support frame during relamping.

E. Design fluorescent rapid start fixtures, 40W and smaller, to incorporate a grounded metal starting aid such as reflector, ballast channel strip, at least 1 inch wide over full length of lamp and within maximum ½ inch distance from lamp per ANSI C82.1.

F. Design fixtures such that case temperature of ballast does not exceed 90 degrees C.

2.04 LIGHT EMITTING DIODE (LED) LUMINARIES

A. All Luminaires
   2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
   3. Comply with In-Situ testing for more reliable results.
   4. LED’s shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
   5. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
   6. LED luminaires shall deliver a minimum of 60 lumens per watt.
      a. LED’s shall be “Bin No. 1 quality.”
   7. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
   8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
   9. LED color temperatures: CRI> 85, 2700K as noted +/- 145K.
   10. LED color temperatures: CRI> 85, 4000K as noted +/- 275K.
   11. LED color temperatures: CRI> 85, 5000K as noted +/- 283K.
   12. Luminaries shall have internal thermal protection.
13. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.


15. Color maintenance over rated life shall be within .007 of CIE 1976.

16. Indoor luminaires shall have a minimum CRI of 85.

17. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management.

18. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.

19. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers

1. Power Factor: 0.90 or higher.

2. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.

3. Output operating frequency: 60Hz.


5. Total Harmonic Distortion Rating: 20% Maximum.

6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.

7. Primary Current: Confirm primary current with Drawings.


9. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

10. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.

2. The Contractor to ensure that external control equipment is compatible with LED control requirements.

3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.

4. For control components that are part of overall area control system see Dimming Controls Specifications.

5. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.

2.05 BALLASTS

A. Acceptable Manufacturers:

1. Advance

2. Universal Lighting Technologies

3. Sylvania

4. Lutron

B. Fluorescent Ballast – Electronic Type:

1. Fluorescent lamp ballasts for T8 and biax lamps shall be high frequency electronic type, operating lamps at a frequency of 20 KHZ or higher with no detectable flicker.

2. Ballasts shall be instant start.
3. Ballasts manufacturers shall have been producing electronic ballasts in the U.S. for more than 10 years with a low failure rate.
4. Ballasts shall be approved and listed by Underwriters Laboratories, Inc.
5. Ballasts shall comply with all applicable state and federal efficiency standards.
6. Ballasts shall comply with FCC and NEMA limits governing electromagnetic and radio frequency interference and shall not interfere with operation of other normal electrical equipment.
7. Ballasts shall meet all applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. Total harmonic distortion shall be less than 20% and input current third harmonic content shall not exceed 10%. Ballasts to be surge and transient protected to 600 volts.
8. Ballasts shall be a high frequency electronic type and operate lamps at a frequency above 42kHz to avoid interference with infrared devices.
9. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
10. Ballasts shall provide transient immunity as recommended by ANSI C62.41.
11. Ballasts shall operate lamps with no visible flicker (<3% flicker index).
12. Ballasts shall tolerate sustained open circuit and short circuit output conditions without damage.
13. Lamp current crest factor (ratio of peak to RMS current) shall not exceed 1.6 and ballast factor shall be not less than .87.
14. Ballasts shall operate at an input frequency of 60 HZ and an input voltage of 108 to 132 (120V models) or 249 to 305 (277V models).
15. Ballasts shall have power factor above 97%, sound rated “A” or better, and contain no PCB’s.
16. Ballasts shall operate as a parallel circuit to allow remaining lamp(s) to maintain full output if companion lamp(s) fail.
17. Ballasts shall be provided with integral leads, color-coded to ANSI standard C82.11.
18. Ballasts shall be capable of being tandem wired up to a maximum distance of 20 feet of lead length.
19. Ballasts shall provide for instant start of lamps at 0 degrees F where fixtures are located outside.
20. Use one lamp and two lamp ballasts where dual level switching is required. Refer to Fluorescent Fixture Wiring requirements in this specification section for limitations.
21. Ballast shall carry five-year warranty, including labor allowance.

C. Compact Fluorescent Ballast – Electronic Type:
1. Ballasts shall be meet requirements of paragraph B. above with the following exceptions noted below:
   a. Ballasts shall be programmed rapid start.
   b. Ballasts shall be multi-voltage and shall operate with an input source of 108 volts through 305 volts and sustained variations +/- 10% with no damage to the ballasts.
   c. Ballasts shall have a minimum ballast factor of .93 for 13 watt through 42 watt T4 and T5 compact fluorescent lamps.
   d. Input current Total Harmonic Distortion shall not exceed 10%.
   e. Ballasts shall have a power factor greater than .96.
   f. Ballasts shall incorporate lamp shutdown circuitry for end of lamp life protection.
   g. Ballasts shall allow for re-lamping without the need to cycle power.
   h. Ballasts shall be furnished with poke-in wire tap connectors or integral leads color-coded to ANSI C82.11 where applicable.
D. Fluorescent Ballast – Dimming Type:
   1. 1% Fluorescent dimming ballast shall be Lutron type Hi-lume® series.
   2. 5% Fluorescent dimming ballast shall be Lutron type Compact SE® series or Advance Mark X®.
   3. 10% Fluorescent dimming ballast shall be Lutron type ECO-10® series or Advance Mark X®.

E. Fluorescent Battery Backup Ballasts
   1. Liner Lamps – Bodine B50 (1100-1400 Lumens)
      a. Operates 2 lamps
      b. Operates lamps for minimum of 90 minutes
   2. Compact Fluorescent – Bodine B84C (325-1000 Lumens)
      a. Operates 1 lamp
      b. Operates lamp for 120 minutes

F. High Intensity Discharge (HID) Ballast:
   1. Pulse start type – metal halide.
   2. High power factor (HPF) reactor type, 90% or higher-high pressure sodium.
   3. Ballasts shall have a ballast factor of 1.0 and a power factor of .90 minimum.
   4. Ballasts shall have no exposed live parts.
   5. Line current during starting shall be less than normal operating current.
   6. Allowable line voltage range +/- 5%.
   7. Outdoor ballast shall operate to 0 degrees F.
   8. Dimming ballasts for 400 watt metal halide lamps shall be Universal #1110-247SC-TC.
   9. All H.I.D. ballasts for indoor use shall be magnetically isolated from all fixture parts and vibration isolated from mounting surfaces.
10. Extra quiet ballast shall be furnished wherever H.I.D. fixtures are specified. All ballasts for lamps less than 400 watt shall be “B” sound rated. Any noisy ballast shall be replaced at no additional cost to the Owner. Acceptable noise levels will be judged by the Architect and/or Engineer.

2.06 LENSES / LOUVERS / TRIM

A. Acceptable Manufacturers:
   1. American Louver.

B. All lenses and louvers shall be positively held within the door frame so that the lenses/louvers will not fall out when hinged door is opened or fixture trim is removed.

C. Recessed fixtures with removable trim that serves as ceiling trim, provide trim that is positively held to the fixture body by adjustable means that permit the trim to be drawn up to the ceiling as tight as necessary to insure complete contact of trim with ceiling.

D. Plastic fixture lenses and diffusers, 100% clear virgin acrylic material. Lenses shall be minimum .125 overall thickness.

E. Where fixture glass lenses are specified, glass lenses shall be provided and plastic lenses shall not be substituted.

F. Provide clear tube guards over exposed fluorescent lamps in all strip and industrial fixtures in unfinished spaces. Equal to ALP Protect-A-Lamp.
2.07 LAMPS

A. Acceptable Manufacturers:
1. G.E.
2. Osram-Sylvania
3. Philips Lighting Company
4. Venture

B. General
1. In areas where there is exposed food, clean equipment, utensils, and linens, or unwrapped single-service and single use articles, lamps shall be shielded, coated, or otherwise shatter-resistant.

C. Low Voltage Lamps:
1. All Low Voltage lamps shall be of the same manufacturer.
2. Rated at 12 V and sizes as noted in Lighting Fixture Schedule.
3. Minimum Lamp life of 4000 hours.

D. Fluorescent Lamps:
1. General
   a. All Fluorescent lamps shall be of the same manufacturer.
   b. Lamps in remodeled areas shall match color of existing lamps in area.
   c. Lamps shall conform to ANSI C78.
   d. Color – Kelvin temperature of lamps shall be (3500° K), (4100° K) or as noted on lighting fixture schedule.
   e. Minimum color rendering index (CRI) of 82.

2. T5 Lamps
   a. Lamps shall be rated at:
      1) Normal Output – 28 watts (48”), 21 watts (36”) nominal.
      2) High Output – 54 watts (48”), 39 watts (36”) nominal.
   b. Initial rated lumen output shall be minimum @ 77 degrees F:
      1) Normal Output – 2,600 lumens (48”), 1,890 lumens (36”).
      2) High Output – 4,400 lumens (48”), 3,080 lumens (36”).
   c. Lamp shall have mini bi-pin base.
   d. Rated lamp life shall be a minimum of 20,000 hours.
   e. Maximum length of 48” nominal.

3. T8 Lamps
   a. Lamps shall be rated at 32 watts (48”), 25 watts (36”) nominal.
   b. Lamp shall have medium bi-pin base.
   c. Initial rated lumen output shall be minimum 2,850 lumens (48”), 2,225 lumens (36”).
   d. Rated lamp life shall be a minimum of 20,000 hours.
   e. Maximum length of 48”.

E. Compact Fluorescent
   a. Lamps shall be rated at 13, 18, 26, 32, 42 watts nominal as noted on fixture schedule.
   b. Lamp shall have base compatible with fixture socket.
   c. Rated lamp life shall be a minimum of 10,000 hours.

F. High Pressure Sodium Lamps:
1. All High Pressure Sodium lamps shall be of the same manufacturer.
2. Clear, 24,000-hour, size per Lighting Fixture Schedule.
3. Rated lamp operating position shall be suited for fixture.
4. Lamp shall have base compatible with fixture socket.
G. Metal Halide Lamps
   1. All Metal Halide lamps shall be of the same manufacturer.
   2. All Metal Halide lamps shall be pulse start.
   3. Rated lamp operating position shall be suited for fixture.
   4. Lamp shall have base compatible with fixture socket.
   5. Fixture wattage shall be as on Lighting Fixture Schedule.
   6. Rated lamp life shall be minimum of 15,000 hours-vert./10,000 hours-Hor. through 150 watt lamps, and 20,000 hours-vert./15,000 hours-Hor. through 1000-watt lamps.
   7. Minimum color rendering index (CRI) of 75 through 150-watt lamps and 65 through 1000 watt lamps.
   8. Lamps shall be clear or coated, as specified or as required for proper fixture performance.

2.08 FLUORESCENT FIXTURE WIRING

A. Where there are two or more fluorescent lamps in a single fixture, or dual level control is indicated on the drawings, multiple-lamp ballasts shall be used to the greatest extent possible and the following tandem wiring configurations shall apply:
   1. One-lamp electronic ballasts may be used only if there are an odd number of fixtures in the room, or if a fixture is separated by more than 10 feet from any other fixture with electronic ballasts or if the nearest fixture is on another control circuit. Otherwise, a lamp in one fixture shall be tandem wired, that is, connected to a multi-lamp ballast in another fixture.
   2. If “inboard-outboard” dual level control (switching) is specified for three-lamp fixtures, then the two outboard lamps shall be connected to a single two-lamp ballast within each fixture. The inboard lamps of two adjacent fixtures shall be tandem wired, that is, connected to a two-lamp ballast within one fixture.

PART 3 EXECUTION

3.01 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.
B. Extend existing interior luminaire installations using materials and methods [compatible with existing installations, or] as specified.
C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.02 INSPECTION

A. Examine areas and conditions under which lighting fixtures are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.
B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Architect’s and/or interior designer’s reflected ceiling plans show actual location of fixtures. Report to Architect/Engineer any conflict between these plans and electrical documents.
B. Architect’s and/or interior designer’s elevation and/or section plans may show actual location of fixtures that are not documented on the reflected ceiling plans. If fixtures are not shown on elevations and/or sections, install at height noted on the electrical documents. Report to Architect/Engineer any conflict between these plans and the electrical documents.

C. Verify adequacy of headroom and non-interference with other equipment such as ducts, pipes, and openings. Report to Architect/Engineer any conflict between these plans and electrical documents.

D. Install fixtures in mechanical and unfinished areas after ductwork and piping installation. Adjust fixture locations to provide the best lighting for equipment access and service locations. Locate fixtures 8’6” above floor, or at suitable locations within space or on walls but not lower than 7’-0”.

E. Adjustable fixtures, track fixtures, floodlights and accent lights shall be aimed as directed by the Architect/Interior Designer/Engineer. Outdoor landscape and accent lighting shall be aimed in periods of darkness.

F. Install in accordance with manufacturer’s written instructions and applicable requirements of NEC.

G. Provide proper bushings for wire entrances. Ground fixture chassis to conduit system.

H. Coordinate with trades so lighting fixtures are properly aligned with items such as diffusers, grilles, and speakers.

I. If necessary, relocate fixtures as directed so there will be no conflict with other equipment.

J. Align stem-mounted fixtures using swivel aligners and stem lengths as required. Verify stem lengths.

K. Make fixture holes for wire entrance with knock-out punches or hole saw, remove burrs. Do not cut holes with tinsnips.

L. Special care shall be taken to assure light-tight joints between recessed fixtures and ceiling.

M. Recessed lighting fixtures which are installed in a rough textured ceiling surface whereby light may be emitted between fixture frame and ceiling surface shall have black self adhesive polyfoam gasketing installed around inside edges of frame to prevent light leaks.

N. Install fixtures in a workmanlike manner. Care shall be taken in placement of fixture outlets and surface-mounted fixtures to maintain alignment, spacing, layout, and general arrangement shown on drawings. Contractor may vary these dimensions slightly in order to clear obstructions. Any major changes in the arrangement must be approved by Engineer.

O. Align and plumb rows of light fixtures.

P. Provide additional trim as required for neat plumbing of recessed fluorescent lights mounted in patterns.
Q. Maintain clearance as required in Section 410-66 of the NEC. Notify Engineer of any conflict, prior to roughing-in.

R. Comply with all relevant Federal, State, Local, and Agency guidelines when disposing of lighting waste. Most fluorescent and HID lamps require special handling and disposal procedures.

S. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.

T. Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.

U. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

V. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.

W. Install recessed luminaires to permit removal from below.

X. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

Y. Install clips to secure recessed grid-supported luminaires in place.

Z. Install wall-mounted luminaires at height as indicated on Drawings or as scheduled.

AA. Install accessories furnished with each luminaire.

BB. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.

CC. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

DD. Install specified lamps in each luminaire.

EE. Interface with air handling accessories furnished and installed under Section 23 37 00.

FF. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.04 FIELD QUALITY CONTROL

A. See Division 1 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation. Correct malfunctioning units at site, then restart to demonstrate compliance. Otherwise, remove and replace with new units and proceed with retesting.

3.05 ADJUSTING

A. See Division 1 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Aim and adjust luminaires to satisfaction of Engineer. Adjustable exterior fixtures shall be adjusted after dark.
3.06 CLEANING

A. See Division 1 - Execution and Closeout Requirements: Final cleaning.
B. Remove dirt and debris from enclosures.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.
E. Remove conspicuous trade labels.

3.07 PROTECTION OF FINISHED WORK

A. See Division 1 - Execution and Closeout Requirements: Protecting finished work.
B. Relamp luminaires having failed lamps at Substantial Completion.
C. Protect installed fixtures from damage during remainder of construction period

END OF SECTION
PART 1  GENERAL

1.0.  PURPOSE

A. The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV's requirements in excess of twenty years.

B. Product specifications, general design considerations and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful Contractor shall meet or exceed all requirements for the cabling system described in this document.

C. This specification is intended to provide general design guidelines for new construction and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an Electrical Subcontractor under the General Contractor, the specifications included in this document are intended as supplemental information to ensure an acceptable, effective installation.

1.01  CONTRACTOR QUALIFICATIONS

A. The Contractor must possess a valid State of Nevada Contractor's License and have successfully performed a minimum of three projects of low voltage cable installation of a similar size and scope within two years of the date of the job bid date. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, start and end dates, and contact information. For projects that require a Request for Proposal, this information will be required as part of the submittal. See section 1.03 for more details. For work that does not require a Request for Proposal, this information should be made available upon request.

B. All Contractor personnel on UNLV projects shall have been trained on the work they will be performing. They shall have been trained on the Contractor's company policies with respect to safety, telecommunications industry cabling quality and neatness standards, and use of Construction Standard Institute (CSI) standard specifications and drawings.

C. The Contractor, at all times during performance and until work is completed and accepted, shall have on the premises a competent supervisor, satisfactory to UNLV and with the authority to act for the Contractor. The supervisor must be a BICSI Certified Installer and a BICSI member in good standing.

D. As a requirement to bidding and performing awarded work, the Contractor must have a current BICSI Certified Registered Communications Distribution Designer (RCDD) on staff, either as a full-time employee or as a hired consultant. At UNLV's discretion, on a project-by-project basis, a RCDD consultant may be hired by the university to inspect work during the project and after completion. In these cases, the RCDD requirement will be met by the university and the Contractor will not be required to have a RCDD on staff.
Based upon the inspection by UNLV’s hired RCDD consultant or Network Development and Engineering staff, the Contractor will be responsible for correcting any work that does not meet requirements detailed in this document at no cost to UNLV.

E. For projects that require a Request for Proposal, the RCDD certificate and BICSI member number will be required as part of the submittals. See section 1.03 for more details. For work that does not require a Request for Proposal, this information should be made available upon request.

F. For jobs in which more than 24 data connections will be installed, weekly inspections and approval of all work performed shall be conducted by the Contractor’s RCDD certified employee. The Contractor will submit a weekly status report to UNLV detailing what work has been completed and inspected. The report will also include any issues encountered as part of the install. See Appendix A5 for report template.

G. The Contractor must provide at least one lead technician on site at all times during the project who is a BICSI Certified Installer and a BICSI member in good standing. For projects that require a Request for Proposal, a copy of the certificate and BICSI member number will be required as part of the submittals. See section 1.03 for more details. For work that does not require a Request for Proposal, this information should be made available upon request.

1.02 APPLICABLE REGULATIONS

A. Related Documents – Equipment and material shall be labeled as Underwriters Laboratories Listed. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency:

1. ANSI/TIA-569-D Telecommunications Pathways and Spaces
2. ANSI/TIA-568-D.0 Generic Telecommunications Cabling for UNLV Premises
3. ANSI/TIA-568-D.1 Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
5. ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard
6. ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure
7. ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for UNLV Premises
8. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
9. National Electrical Manufacturers Association (NEMA)
10. National Electrical Code, latest revision (NEC)
11. National Fire Protection Agency (NFPA) – 70
12. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
13. UL 497 Protectors
14. UL 1459 Standard for Safety for Telephone Equipment
15. UL 1863 Standard for Safety for Communications Circuit Accessories
16. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
17. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials
18. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
20. ANSI/EIA 310D
1.03 SUBMITTAL

A. For jobs that require submittals, the Contractor shall furnish the following in a single, consolidated submittal for Approval copy by UNLV.
   1. Contractor's license number and proof of qualifications.
   2. A copy of the RCDD certificate and BICSI member number as described in the above Contractor Qualifications section.
   3. A copy of the BICSI certificate and the BICSI member number of the lead technician as described in the above Contractor Qualifications section.
   4. A copy of the BICSI certificate and the BICSI member number of the supervisor as described in the above Contractor Qualifications section.
   5. For all Category 6 and 6A installations, provide the manufacturer training certificates with a brief description of the training courses associated with each certificate.
   6. Reference sheets with three references. Each reference shall include a brief description of the project, the start and end dates, and contact information.
   7. The make and model of the materials to be used.

1.04 DESIGN REQUIREMENTS

A. Work must conform to the design requirement for each identified element.

B. Building Service - Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for an air-blown fiber tube-cell to enter through individual 4" conduits from the campus underground plant from two diverse locations. Exact air-blown fiber tube-cell conduit size will be determined by UNLV Network Development and Engineering on a project by project basis. Voice cables (minimum 50 pairs) shall enter the building from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4-inch conduits to the campus underground plant for later use by UNLV. All raceways to have 880 lb. test nylon pull strings installed. All new service entrance conduits shall be a minimum 4-inch trade size and of sufficient number to provide 50% growth capacity and will terminate 4-inches above finished floor in the MDF (main distribution frame) room inside the building.
   1. Service Data: Data communication service to each building shall consist of a minimum of 72 strands of 9.0/125-micron single mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own air-blown fiber tube-cell conduit. Single mode fiber is to be terminated with LC style connectors, UPC. Single mode fiber shall be terminated in a separate rack mounted fiber optic enclosure. The Contractor shall install an air-blown fiber distribution unit in all MDF and IDF locations. Each fiber optic enclosure must be labeled with building, IDF room number and the fiber optic enclosure of opposing end. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. Service loops of fiber optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirement and cable management will be provided by UNLV Network Development and Engineering.
   2. Service – Voice: Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50 pair twisted cable. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on
B. Service Entries - Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100-volt range. Building entry conduit shall allow for 50% growth and have a minimum of four 4” conduits from manhole to MDF room.

C. Manholes - All manholes shall be at minimum four feet wide by four feet deep by four feet tall and encased in concrete. All cables shall have service loops that are racked and mounted inside. Inside of each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas or 6” above finished grade in landscaped areas.

D. Cable Splicing – Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fiber optic strands of the exact make and model on each end using factory terminated connectors on pigtailed splicing. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices are not acceptable. The following cable splicing techniques and materials for copper cable shall be utilized:

1. Preparation for Splices – All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcase 4435 non-conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcase 4414 or 4415 or UNLV approved equal.

2. Splicing Requirements
   a. Splice cases will not be permitted in cable trays.
   b. All splice closures for use in underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
   c. End caps must be tapered and flexible and be capable of separate cable entries.
   d. Rigid bonding and strain relief bars must be an integral part of the finished enclosure.
   e. Re-enterable polyurethane compound shall be used.
   f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
   g. Supports: All cable splices shall be supported by a minimum of two 2-inch cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole rack, or University approved equivalent.
   h. Enclosures: 3M splice enclosures or University approved enclosures shall be used for splicing throughout the system.
   i. Protection: All cable splices must be protected from damage at sheath openings. Mechanically protect all conductors utilizing 3M Scotchcase Pair Saver 4458 or approved equivalent.

E. Building Voice and Data Terminal Rooms – All new building structures shall have, at a minimum, one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications
   a. The MDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited
Communications bonding to Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.

b. Each MDF will be provided with an isolated electrical panel with 200-amp service.

c. The MDF will require the installation of a telecommunications main grounding busbar (TMGB) to the service equipment (power) ground with a conductor the same size as the largest telecommunications bonding backbone (TBB). The connections of the bonding conductor for telecommunications (BCT) and the TBB to the TMGB shall utilize exothermic weld, Listed compression two-hole lugs, or two-hole exothermic lugs. All equipment racks shall be connected to the TGB with a telecommunications equipment bonding conductor (TEBC) that is continuous copper not less than #6 AWG.

The TMGB shall:

1) Be provided with holes for use with correctly matched listed lugs and hardware.
2) Be made of copper, or copper alloy having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
3) Have minimum dimensions of ¼-inch (6.35mm) thick by 4-inch (100mm) wide and shall be long enough to accept all current connections with additional room for growth.
4) Be listed by authority having jurisdiction.

d. Each MDF will have two quad 20-amp, 110 VAC outlets, terminated with NEMA 5-20Rs, two 30-amp 208 VAC outlets, terminated with NEMA L6-30Rs and two 20-amp NEMA L6-20Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks at standard outlet height.

e. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36” wide and 80” high.

f. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14’ x 10’ and not have false floors or ceilings.

g. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

h. A separate HVAC thermostat control will be installed for all MDF rooms and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

i. All MDFs shall be secured using a UNLV-approved card access reader and strike.

j. All MDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part # WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of two walls must be covered by backboards as defined in Part 2.
m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

2. Intermediate Distribution Facilities (IDFs)
   a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.
   b. Each IDF will be provided with a TGB connected by a TBB to the TMGB. The TBB shall be no smaller than a #6 AWG conductor and/or use the recommended sizes in accordance with ANSI-TIA-607-B. All equipment racks shall be connected to the TBB with a TEBC that is continuous copper not less than #6 AWG.

   The TGB shall:
   1) Be provided with holes for use with correctly matched listed lugs and hardware.
   2) Be made of copper, or copper alloy having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
   3) Have minimum dimensions of ¼-inch (6.35mm) thick by 4-inch (100mm) wide and shall be long enough to accept all current connections with additional room for growth.
   4) Be Listed by authority having jurisdiction.
   5) Where a grounding equalizer (GE) is required it shall be bonded to the TGB.

   c. Each IDF will have two quad 20-amp, 110 VAC outlets, terminated with NEMA 5-20Rs and two 30-amp 208 VAC outlets, terminated with NEMA L6-30Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, at standard outlet height.

   d. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36” wide and 80” high.
   e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8’ x 10’, and not have false floors or ceilings.
   f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
   g. A separate HVAC thermostat control will be installed for all IDF rooms and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
   h. All IDFs shall be secured using a UNLV-approved card access reader and striker, the access of which is to be managed by the Network Operations Center.
   i. All IDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part # WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.
j. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of four walls must be covered by backboards as defined in Part 2.

m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

F. Building Interiors

1. Underground Plant - The cables from the underground plant shall enter the building in the MDF. Appropriate wire management shall be installed such as ladder racks, D-rings, and hook-and-loop tape so as not to exceed the acceptable cable bend radius.

2. Data Rooms - Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.

3. Internal Backbones (Risers) - A minimum of two 4" conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of single-mode fiber, as defined in Part 2. Fiber optic cable is to be contained inside air-blown, tube-cell conduit, Sumitomo part # TC07TRX. 12 Cat6 provided between every IDF and the MDF. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring

a. Data Outlets - All outlets shall be constructed using single gang, 4-port faceplates, colored almond or similar. All outlets shall have at least two network drops each. The ports on the left side of the faceplates will always correlate to an odd numbered patch panel port. The ports on the right side of the faceplates will always correlate to an even numbered patch panel port.

b. Copper Cabling - All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jacks. Every cable shall be continuous and un-spliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part 2.

c. Habitable Space Provisioning - Every habitable space shall be provisioned a minimum of one outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.

d. Non-habitable Space Provisioning - Every non-habitable space shall be provisioned with one outlet every 500 ft², minimum of one per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

e. Labeling - The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall
match the corresponding patch panel port number for each drop. The drops will be in consecutive order whenever possible. They shall increment left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the As-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable and placed within view at the termination point on each end. Faceplate labels will be the manufacturer’s labels provided with the outlet assembly unless otherwise specified. The labeling schema shall be as follows:

1) All labels will be in the format of “310-306-1-24” where “310” is the Station room number, “306” is the IDF, “1” is the Patch Panel identifier and “24” is the port that the drop terminates to on the patch panel.

2) Cable Wrap labels: Wrap labels are required within 6 inches of the cable’s termination point at both ends. Wrap labels will follow the format listed in this section, i.e. “310-306-1-24”. Splitting this into two lines is acceptable in which case “310-306” would go on the first line and “1-24” would go on the second line. The font size will be the largest size that fits the required information but no smaller than 8-point font.

3) Station labels – The Station label will follow the format listed in this section. However, the top label includes both top ports, i.e. “310-306-1-24,25”. The first patch panel port will always be the left faceplate port and the second patch panel port will always be the right faceplate port. The bottom label will follow the same guidelines when used. When unused the label will be left blank. The font size will be the largest size that fits the required information but no smaller than 10-point font. See “Standard Outlet Configuration” in Appendix A2.

4) Data Room Patch Panel - The patch panel identifier will be labeled by the installer on the left side of the patch panel in a place that is easily visible. Counting from the top of the rack down, the first installed patch panel will be identified with the number 1, the second with the number 2 and so on. The patch panel port label will be in the format listed above “310-306-1-24”. Space limitations will require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8-point font. These labels should be center justified and located directly above the port they are labeling or in other manufacturer provided locations for port labels.

5. Wireless – 802.11
   a. Data cabling at wireless locations shall be terminated in electrical boxes that are mounted parallel to the ceiling, above the drop ceiling grid panels. Two blue data cables shall be directly run from and IDF and will be terminated on data jacks. The jacks will be mounted in a faceplate and the faceplate will be mounted to the electrical box. For existing buildings, the Contractor shall provide 5 feet of data cabling service loop at the electrical box. For new buildings, the Contractor will provide a minimum of 20 feet of data cabling service loop at the electrical box.
   b. Electrical boxes used for wireless AP installations shall have a minimum clearance of 14” x 14” x 8” and will be mounted to a wall or secured to equipment that meets local NEC, ANSI/TIA-568-C, and ANSI/TIA-569-C standards. No cable run from IDF to connection point may exceed 300 feet.
c. At each access point location, connect the access point to the horizontal cabling using Contractor provided patch cords (see section 2.02B for patch cable requirements). The cable that correlates to an odd numbered patch panel port will plug into the access point’s LAN port and the cable that correlates to an even numbered patch panel port will plug into the access point’s CONSOLE port. All patch cords will use appropriate J-hook/supports or dressing.

d. Wireless locations that are placed in locations with a hard-lid ceiling will have the cables be terminated inside of the electrical box but not placed in a faceplate. The electrical boxes at these locations shall be 4-inch square boxes with a depth of 3½-inch, or 5-inch square boxes. Each box must maintain the minimum bend radius of the cable.

e. Access point installations other than hard-lid locations will require the Contractor to use a UNLV provided bracket. This might require the Contractor to cut a hole in drop ceiling acoustic tile. See Appendix A4 for an example of this install.

f. For new buildings only, the Contractor will be required to move the APs and electrical boxes utilizing the service loop as required after UNLV completes a wireless survey.

6. Wireless Access Points Placement and Wireless Overlay for 802.11 - Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include, but are not limited to the following:
   a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
   b. Installations which require access points to use antennae other than the standard dipole antennae.
   c. The finished ceiling plan is exposed, and UNLV has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building. Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays – All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.
   a. Supports - Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2” in diameter.
   b. Capacity - Cable trays shall be sized for a minimum growth of 50%.
   c. Grounding – Cable trays shall be grounded in accordance with ANSI/TIA-607-B.

8. Cable Installation –
   a. Copper - Installation is to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. Completed installation is to be Certified Category 6 or 6A using the ANSI/EIA/TIA 568-C.2 testing standard or better. Test documents/results to be supplied to UNLV in .PDF format. Completed installation is to be approved by UNLV Network Development and Engineering.
   b. Fiber – Installation is to meet or exceed ANSI/EIA/TIA-568-C.3 testing standard or better. Test documents/results to be supplied to UNLV in .PDF format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes:
   Location - Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in the ceiling for conduits larger than 2-inches in diameter. Conduits larger than 2-inch diameter, entering a box shall be routed down a wall or column and the box shall be installed
accordingly. All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.

a. Access – Provide boxes with a suitable cover.

G. Grounding:
1. Regulations - All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC), ANSI/TIA-607-B and all other applicable codes and regulations.
2. Installation Requirements - Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.
3. Grounded Connectors - Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required, they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas pipe as the grounding electrode.

PART 2 PRODUCTS AND ACCEPTED MATERIALS

2.0 GENERAL –

A. All material required for a complete installation shall be furnished by the Contractor unless otherwise specified by UNLV Planning and Construction Department.

B. All materials provided by the Contractor must be new, free from defects and must meet UNLV’s specifications. A parts list for the approved manufacturers can be found in Appendix A6. For projects that require a Request for Proposal, bidders shall submit the make and model of materials that will be used as part of their submittal. See section 1.03.

C. All fixtures and hardware must be installed as per requirements detailed in this document. No custom items shall be used except as reviewed and approved by Network Development and Engineering. The Contractor shall be held financially responsible for any work or re-work required due to improper approval and/or acceptance of that work performed which differs from the construction documents.

D. All products shall be new and brought to the job site in original manufacturer’s packaging. Electrical components (including innerduct) shall bear the Underwriter’s Laboratories label.

E. All station cables shall be Rise (CMR) rated when entire cable runs are installed in conduit.

F. All station cables shall be Plenum (CMP) rated when any section of the cable run is not installed in conduit.
G. The Contractor shall inspect all products and materials prior to installation. Damaged cable or any other components failing to meet specifications shall not be used in installation.

2.01 BACKBOARDS

A. All backboards required in the IDF/MDF rooms shall be plywood, ¾ inch by 4 inches by 8-foot sheets, grade AC, treated on one side with fire resistant paint or material, installed with finished (painted/treated) side exposed.

2.02 CABLE SPECIFICATIONS

A. Warranty - All copper and fiber cabling installations shall be covered by an end-to-end manufacturer warranty of no less than 20 years. Contractors must be certified installers of the products they select for installation. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

B. Approved Cabling Manufacturers

1. Copper installation – Contractors may select from the following list of approved copper cabling manufacturers:
   a. Commscope
   b. Leviton
   c. Siemon
   d. TE Connectivity

2. Products selected from these Contractors must meet requirements detailed in this document.
   a. New Building – All copper installations in new buildings on campus will be completed using products from a manufacturer on the approved list. All cabling and components will be certified Category 6A / Class Ea and will meet all requirements listed in Section 2.02-C.
   b. Existing Building – In cases where Contractors install cabling in existing IDF's, installers shall use open ports on existing Category 6 patch panels. The warranty requirements listed in Section 2.01-A will apply to these installations. This will require Contractors to be certified installers for existing components in the IDF. If there are no open ports, not enough ports to complete the job, the existing patch panel is not Category 6, or the installer is not a certified installer of the existing components, the Contractor will use a Leviton QuickPort patch panel (Model number 49255-H48) or equivalent that has been viewed, tested and approved by Network Development and Engineering staff. The installer shall use authorized products that they are certified to install from a manufacturer on the approved list in Appendix A6.

3. Fiber installation – Contractors may select from the following list of approved air-blown fiber cabling solution manufacturers where air-blown fiber is required:
   a. Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
   b. eABF solutions by AFL/Duraline

4. Contractors may select from the following list of approved fiber cabling solution manufacturers where air-blown fiber is not required:
   a. AFL
   b. TE Connectivity
   c. Siemon
   d. Leviton
   e. Commscope
   f. Corning
5. Products selected from these Contractors must meet requirements detailed in this document.
   a. Building to Building – All fiber installations for building to building interconnects shall use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
   b. New Building – All fiber installations for new buildings on campus, including building to building interconnects and MDF to IDF connections shall use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.

C. Data Copper – All copper data for existing buildings will be Category 6, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO/IEC Category 6 / Class E requirements. All copper data cable for new buildings will be Category 6A, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO/IEC Category 6A / Class Ea requirements. Only materials from accepted manufacturers in [Section 2.01B](#) shall be installed. Cable shall be rated as plenum or riser based on installation requirements.

D. Patch cables – All patch cables installed by the Contractor will be factory terminated and tested to meet requirements stated in [Section 2.02.C](#).

E. Exterior cable – All telephone cable that supports devices external of a building, such as emergency phones shall use Superior Essex cable part # 09-092-02, 6 pair buried drop.

F. Single-mode Fiber Optic – All single-mode fiber optic cable must be 9.0/125. All single-mode terminations are to be LC, UPC finish. A 12- or 24- fiber adapter panel must be used in the fiber optic enclosures.

G. Air-Blown Fiber Components – Tube cell count for tube-cell cabling will be determined by UNLV Network Development and Engineering Staff on a project by project basis. All new building IDFs and MDFs will require the installation of fiber distribution devices. Other locations such as manholes and other splice or junction locations will require fiber distribution boxes as needed.

2.03 DATA TERMINATIONS

A. Copper Data Components
   1. Patch panels – All data patch panels for existing buildings are to be a Leviton QuickPort patch panel, (part #49255-H48) or equivalent, that has been viewed, tested and approved by Network Development and Engineering Staff. Equivalent patch panels must accept keystone Category 6 or 6A jacks, in 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6 / Class E or Category 6A / Class Ea requirements. They must also be capable of housing keystone data jacks from other manufacturers, be viewed, tested and approved by Network Development staff and engineering. Every group of 48 cables must be separated by 2U of horizontal cable management, Panduit part # WMPF1E. All cabling will route through the rear cable management prior to termination in the patch panel. All terminations are to follow ANSI/EIA/TIA 568-B.  
   2. Voice Copper Termination Blocks – All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.
   3. Data Jacks – All data jacks for existing buildings shall be modular, unshielded, 4 pair, 8P8C, Category 6, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6 / Class E requirements. Data jacks must be compatible with patch panel from [Section 2.03.A.1](#). Compatible jacks
are listed in Appendix A6, in each manufacturer section, item description “Jacks-Universal, Black”.
All data jacks for new buildings shall be modular, unshielded, 4 pair, 8P8C, Category 6A black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6A / Class Ea requirements.
All terminations are to follow ANSI/EIA/TIA 568-B.

4. Faceplates – All faceplates shall be 4-port, light almond (or Contractor equivalent), single gang, low profile with a window for labels. All unused ports must be covered with a blank insert.

B. Fiber Optic
1. Terminations – Terminations will be completed with one of the two following methods:
a. No epoxy/no polish connectors
b. Factory-terminated pigtails with fusion splicing
   Fusion splices will be protected in splice cases or other suitable enclosures.
2. Connectors – Single mode is to be terminated with LC style connectors, UPC Polish
3. Fiber enclosures – TE Connectivity fiber optic enclosures models RMG-2000-000B or RMG-4000-000B shall be used. RMG-4000-000B shall be used when installing more than 24 fiber strands or at the request of Network Development and Engineering. RMG-2000-000B will be used when installing 24 fiber strands or less. Equivalent enclosures can be approved by Network Development and Engineering on a case-by-case basis.
4. Fiber Adapter Panels – Single mode fiber will terminate in 12- or 24- fiber standard adapter panels.

2.04 DATA EQUIPMENT RACKS

A. All racks are to be four post, open frame, square hole, black, Panduit part # R4PCN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.05 CABLE TRAYS

A. All cable trays for distribution of data cables within a building are to be a minimum of 18” wide by 4” deep, solid trough or ladder and will be approved by UNLV Network Development and Engineering.

2.06 EXCEPTIONS

A. Due to unique constraints and requirements of existing IDF’s, exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

PART 3 EXECUTION

The University has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part 3 - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the University to inspect certain material or work, shall mean that the University has the option, rather than the obligation, to do so. Any warranty or
guarantee provisions contained in the Contractors'/Contractors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.01 DEMOLITION

A. Coordination with University Operations - No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. Work to be Performed by Owner - Upon notification by Contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or Out of Service (dead). If station cabling is dead the technician will ensure that all cross connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. Disposal of Surface Mount Raceway - Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.02 EXCAVATION

A. The Contractor shall be required to excavate for underground mechanical piping and shall perform all auxiliary work that may be required to do so.

B. No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The University has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor's expense.

C. Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

D. All underground construction work, during progress and after completion, shall conform truly to lines and grades.

E. If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

F. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

G. Contractor shall not obstruct the gutter of any street or driveway but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.
H. Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

I. Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

J. Grass will be replaced by a method approved by the University.

K. Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.03 INSTALLATION

A. Regulations - All work and materials will comply with all Federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the Contractor will correct the deficiency at no cost to the University.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. Quality Assurance - Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.

C. Damage of Existing Facilities - The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition, any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. Coordination - Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by University personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. Cable Support and Anchors - All cables, wires and equipment shall be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.
All data cables installed without conduit in plenum spaces will be secured using J-hooks or other Network Development and Engineering approved mounting hardware.

F. Firestop Systems - A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using State approved fire-resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:
2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
3. ASTM E 814: Standard Method of Fire Tests of Through Penetration Firestops
4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
6. UL 263: Fire Tests of Building Construction Materials
7. UL 723: Surface Burning Characteristics of Building Materials
8. UL 1479: Fire Tests of Through Penetration Firestops

G. Conduit:
1. Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.
2. Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.
3. All offsets shall be considered equivalent to a 90-degree bend.
4. Sections of conduit longer than 100 ft. require a pull box.
5. Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.
6. Conduits entering the IDF through the wall shall be reamed, bushed, and terminated not more than 4 inches from the wall surface.
7. Conduits entering the IDF from below shall be terminated 4 inches above finished floor.
8. Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4 inches in diameter. They shall be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
9. Conduit installed for data and/or voice cabling may not be shared with any other cable.
10. All conduit runs for station outlets with more than three cables shall be not less than 1 inch in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
11. After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.
12. Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.
13. Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8” in diameter.
14. Conduit shall not block access to existing services.
15. All junction boxes will maintain the minimum bend radius for the cable being installed. Special consideration should be taken concerning the use of Category 6A / Class Ea cabling, data termination jacks, and the minimum bend radius with the required eight (8) inch minimum excess cable at each outlet.

16. Pull boxes shall be installed in position and relationship to adjoining work, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb and straight edges.

H. Cable Installation:
1. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.
2. Any cable to be placed through an electrical room or any other potentially hazardous conditions shall be placed in conduit.
3. All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.
4. All outlets will have a minimum of 8 inches of cable stored at each drop after the cable has been terminated.
5. All data cabling will have a service loop with a minimum of five feet of data cabling that will be placed on the MDF/IDF ladder rack.
6. Where installation of conduit is not required, plenum cable will be used. Cables shall not lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate wire hangers/supports, or dressing will be used.
7. All cabling in an open ceiling and/or open plenum space will be ran in conduit or cable tray.
8. Cable supports are to be anchored in accordance with TIA-569-C and NEC.
9. Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.
10. All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.
11. Installation to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. UNLV Network Development and Engineering must approve completed installation.

I. Cable Testing - All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The Contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including, but not limited to, cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.
1. Copper Data Cable - All data cables shall be tested in accordance with ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard or better as well as industry best practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.
   a. Testing - Each cable shall be tested for wire map, length, and performance. The data cables shall be bi-directionally tested using an ANSI/TIA 1152 level III or better cable analyzer. The cable analyzer shall be within the calibration period recommended by the manufacturer.
   1) Wire map – Each pair of each installed cable shall be tested for opens, shorts, pair reversals, split pairs, transposed pairs and any other mis-wiring. The test shall be recorded as Pass/Fail as indicated by the test set in accordance with the manufacturers recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
2) Length - Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multipair cables, the longest pair length shall be recorded as the length for the cable.

3) Performance Verification - Category 6 or 6A data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, as well as provide results for the following tests:
   a. Propagation Delay
   b. Delay Skew
   c. Insertion Loss
   d. NEXT (Near-End Crosstalk)
   e. PS NEXT (Power Sum Near-End Crosstalk)
   f. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
   g. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
   h. ACR-F (Attenuation to Crosstalk Ratio Far-End)
   i. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
   j. Return Loss
   k. TCL (Transverse Conversion Loss) – recorded for information only
   l. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only

4) Equipment - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C.2, and the result shown as Pass/Fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. Fiber Optic - Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C.3 Standard, and the result shown as pass/fail. The test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-C.3, Optical Fiber Cabling Components.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor’s test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the Contractor's expense.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

a. Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one jumper reference, two jumper test to estimate the actual link loss of the installed cable plus two patch cords. Singlemode fiber optic cable must meet or exceed the following limits:
   1) Attenuation - 0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
   2) Connectors - Max loss for a mated pair of connectors shall be less than 0.5dB.

3. OTDR - Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with ANSI/TIA-568-C.2.. The measurements to determine splice loss shall be performed in accordance with manufacturer’s recommendations and best industry practices.

4. As-Builts - All labeling information shall be recorded on the As-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and its corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions as possible. Hand drawings are not acceptable. As-builts must be provided in both PDF and CAD format. Upon acceptance of contract, Contractor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts and test results and subsequent corrected versions of those documents. Network equipment (Including voice, data, and A/V services) will not be provisioned until this documentation is provided.

J. Ground Testing – Two-point ground and continuity testing will be performed to determine if there is an acceptable maximum level of resistance between any point in the telecommunications bonding and grounding system and the building’s electrical grounding electrode system.
   1. Prior to performing a two-point test, a visual inspection shall be performed to verify the bonding and grounding system is installed according to ANSI/TIA-607-B guidelines.
   2. For the test to be valid, it must be done prior to the installation of the telecommunications equipment.
   3. The recommended maximum value for resistance between any point is 100 milliohms.
   4. The following areas will be tested:
a. TMGB/TBG to the electrical ground from each MDF/IDF.
b. TMGB/TGB to the building steel (if present).
c. TMGB to TGB
d. Building steel (if present) to the electrical ground
e. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project.

PART 4  CONTRACTOR SUMMARY

A. General
   1. This summary is intended to provide an overview of key requirements that Contractors of small data cabling installations will most often need to reference. Contractors will still be responsible for maintaining compliance with the entire wiring specification.

B. Contractor requirements:
   1. Certified installer for one of the approved manufacturers.
   2. RCDD on staff.
   3. Supervisor and/or lead installer shall be BICSI Certified Installers and members in good standing.
   4. For required installations, RCDD will conduct weekly inspections and submit weekly status report to UNLV.

C. Approved manufacturers
   1. Copper
      a. Commscope/Uniprise
      b. Leviton/Berk-Tek
      c. Siemon
      d. TE Connectivity
   2. Fiber
      a. Air-blown fiber
         1) Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
         2) eABF solutions by AFL/Duraline
      b. Non air-blown fiber
         1) Corning
         2) TE Connectivity
         3) Siemon
         4) Leviton
         5) Commscope

D. Warranty
   1. All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. The warranty is required to cover cabling, components and performance. Parts and labor for replacements must also be included in the warranty.

E. Cabling
   1. Copper Data Cabling and Components
      a. New buildings shall be installed with Category 6A cable and components from one of the approved manufacturer’s parts in Appendix A6.
      b. Existing buildings shall be installed with Category 6 cable and components from one of the approved manufacturer’s parts in Appendix A6.
c. All data cabling shall have a service loop with a minimum of 5 feet of data cabling that will be placed on the MDF/IDF ladder rack.

d. All data patch panels for existing buildings are to be Leviton QuickPort patch panels (part # 49255-H48). Equivalent patch panels must accept keystone Category 6 or 6A jacks, 2U, 48 port configuration and must meet or exceed EIA/TIA and ISO/IEC Category 6 / Class E or Category 6A / Class Ea requirements. They must also be capable of housing keystone jacks from other manufacturers, be viewed, tested and approved by Network Development and Engineering staff.

e. All data jacks shall be modular, unshielded, 4-pair, 8P8C, Category 6 or 6A, black unless otherwise specified and must meet or exceed EIA/TIA and ISO/IEC Category 6 / Class E or Category 6A / Class Ea requirements. Data jacks must be compatible with patch panels from section 2.03. A.1. Compatible jacks are listed in Appendix A6, in each manufacturer section, item description, “Jacks-Universal, Black”.

f. Terminations will follow wiring scheme TIA-568-B.

g. Where installation of conduit is not required, plenum cable shall be used. Cables shall not lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.

h. Hook and loop tape is the only approved product for bundling cable. Tie wraps shall not be used to bundle cable.

i. Wire managers will be Panduit part # WMPF1E and part # WMPVHC45E.

j. Racks will be Panduit part # R4PCN.

k. Installations must comply with TIA-569-C and TIA-568-C.2.

2. Fiber Cabling and Components
   a. Air-blown fiber tube cell conduit will be installed in all new buildings and in new building-to-building fiber installations.
   
   b. Air-blown fiber will be used in existing buildings that contain existing air-blown fiber components.
   
   c. Non air-blown fiber will be used in existing buildings that do not contain existing air-blown fiber components.
   
   d. Terminations will be completed using no epoxy/no polish connectors or factory-terminated pigtails with fusion splicing.
   
   e. All fiber will be terminated with LC / UPC connectors and be mounted in 12- or 24- fiber adapter plates.
   
   f. Fiber enclosures will be from a Network Development and Engineering approved manufacturer. Adapter plates shall be of standard size and will fit these enclosures.

F. Documentation
   1. Labeling
      a. Contractor shall be responsible for labeling all installed cables.
         1) The labeling scheme will use the format described in Appendix A2.
         2) Contractor shall label the patch panel port, cable termination points and faceplates.
         3) Contractor shall be responsible for labeling any new patch panels.

   2. Testing
      a. All installed cables will be certified by an approved cable analyzer. Test results will meet TIA-568-C.2 and TIA-568-C.3 requirements. Test results will be provided to Planning and Construction in .PDF format upon completion. Network Development and Engineering will verify all test results prior to activating ports.
a. All installed cables will be documented on an As-built diagram. The diagram will indicate the location and actual label of all installed cabling. As-builts will be provided to Planning and Construction in .PDF format upon completion. UNLV Network Development and Engineering will verify that all the data contained on the As-builts matches the actual labels prior to activating ports.

END OF SECTION
SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Grounding conductors.
   2. Grounding connectors.
   3. Grounding busbars.
   4. Grounding rods.
   5. Grounding labeling.

1.2 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.
B. TGB: Telecommunications grounding busbar.
C. TMGB: Telecommunications main grounding busbar.
D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.3 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
   1. Ground rods.
   2. Ground and roof rings.
   3. BCT, TMGB, TGBs, and routing of their bonding conductors.
B. Qualification Data: For Installer, installation supervisor, and field inspector.
C. Qualification Data: For testing agency and testing agency's field supervisor.
D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
   1. Result of the ground-resistance test, measured at the point of BCT connection.
   2. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Installation Supervision: Installation shall be under the direct supervision of ITS Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
   
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   
   B. Comply with UL 467 for grounding and bonding materials and equipment.
   
   C. Comply with TIA-607-B.

2.2 CONDUCTORS
   
   A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1. Harger Lightning & Grounding.
      2. Panduit Corp.
      3. TE Connectivity Ltd.
   
   B. Comply with UL 486A-486B.
   
   C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
      1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
      2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
   
   D. Cable Tray Grounding Jumper:
      1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
      2. Not smaller than No. 10 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
   
   E. Bare Copper Conductors:
      4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
      5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
      6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.
3. Panduit Corp.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
1. Chatsworth Products, Inc.;
2. Harger Lightning & Grounding;
3. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by minimum 4 inches (6.3 by 100 mm) as required by room. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, [1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19-inch (483mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches (1827 or 914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Harger Lightning & Grounding.
   2. TE Connectivity Ltd.
   3. Lyncole (A VFC Company)

B. Ground Rods: [Copper-clad]; [3/4 inch by 10 feet (19 mm by 3 m)] in diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

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

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for [No. 8] AWG and smaller and stranded conductors for [No. 6] Insert number AWG and larger unless otherwise indicated.
   1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than [No. 6] Insert number AWG.
   2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than [No. 6] Insert number AWG.
B. Underground Grounding Conductors: Install bare [tinne-]copper conductor, [No. 2] Insert number AWG minimum.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

D. Conductor Support:
   1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

E. Grounding and Bonding Conductors:
   1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
   2. Install without splices.
   3. Support at not more than 36-inch (900-mm) intervals.
   4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
      a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than [No. 1/0] Insert number AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than [No. 6] Insert number AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
   1. Use crimping tool and the die specific to the connector.
   2. Pretwist the conductor.
   3. Apply an antioxidant compound to all bolted and compression connections.
D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install [top-mounted] rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using [No. 6] Insert number AWG bonding conductors.
   1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
   2. Bond the TGB of the equipment room to the reference grid at two or more locations.
   3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Will Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer’s written instructions.
   2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
      a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
   a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB [and in each TGB]. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds [5] ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Metal conduits and fittings.
   4. Tele-power poles.
   5. Hooks.

1.2 DEFINITIONS
A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid conduit.
C. IMC: Intermediate metal conduit.
D. RTRC: Reinforced thermosetting resin conduit.

1.3 ACTION SUBMITTALS
A. Product data for the following:
   1. Surface pathways
   2. Wireways and fittings.
   3. Tele-power poles.
   5. Underground handholes and boxes.

PART 2 - PATHWAYS

2.1 SURFACE METAL PATHWAYS
A. Description: Galvanized steel with snap-on covers, complying with UL 5.
B. Comply with TIA-569-D.

2.2 SURFACE NONMETALLIC PATHWAYS:
A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
B. Comply with TIA-569-D.
2.3 TELE-POWER POLES:

A. Description: Prefabricated, finished metal pole with prewired power and communications outlets.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
   1. MonoSystems, Inc;
   2. Panduit Corp;
   3. Wiremold / Legrand;

C. Material: [Aluminum with clear anodized finish].

D. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

F. Comply with TIA-569-D.

2.4 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Erico/Caddy
   2. B-Line

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. [Galvanized] [stainless] steel.

F. [J] [U] shape.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Erickson Electrical Equipment Company;
   2. MonoSystems, Inc;
   3. Stahlin Non-Metallic Enclosures;

C. General Requirements for Boxes, Enclosures, and Cabinets:
   1. Comply with TIA-569-D.
   2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
   3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: [4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)] [4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)] Insert other dimension.

5. Gangable boxes are [allowed]

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, [aluminum], Type FD, with gasketed cover.

F. Metal Floor Boxes:
1. Material: [Cast metal]
2. Type: [Fully adjustable]
3. Shape: Rectangular.
4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, [round] [rectangular].
1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [cast aluminum] [galvanized, cast iron] with gasketed cover.

J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, [Type 1] [Type 3R] [Type 4] [Type 12] Insert type, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:
   a. Material: [Plastic] [Fiberglass].
   b. Finished inside with radio-frequency-resistant paint.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:
1. NEMA 250, [Type 3R] Insert type galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: [EMT] [or] [RNC].
2. Exposed, Not Subject to Severe Physical Damage: [EMT] [RNC identified for such use].
3. Exposed and Subject to Severe Physical Damage: [GRC] [IMC]. Pathway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Gymnasiums
   e. Insert designations of applicable spaces or locations.

4. Concealed in Ceilings and Interior Walls and Partitions: [EMT] [RNC, Type EPC-40-PVC] [or] [innerduct].

5. Damp or Wet Locations: [GRC] [IMC].

6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: [Plenum-type, optical-fiber-cable pathway] [Plenum-type, communications-cable pathway] [EMT].

7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: [Riser-type, optical-fiber-cable pathway] [Riser-type, communications-cable pathway] [EMT].

8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: [General-use, optical-fiber-cable pathway] [Riser-type, optical-fiber-cable pathway] [Plenum-type, optical-fiber-cable pathway] [General-use, communications-cable pathway] [Riser-type, communications-cable pathway] [Plenum-type, communications-cable pathway] [EMT].

9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 [stainless steel] [nonmetallic] units in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use [set-screw] [or] [compression], [steel] [cast-metal] fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds [120 deg F (49 deg C)].

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA/BICSI 568.
   3. TIA-569-D.
   4. NECA 101
   5. NECA 102.
   6. NECA 105.
   7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Pathways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
   2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
   3. Arrange pathways to keep a minimum of [1 inch (25 mm)] [2 inches (50 mm) of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from nonmetallic conduit and fittings to [RNC, Type EPC-40-PVC,] [GRC] [or] [IMC] and fittings before rising above floor.

M. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for pathways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Surface Pathways:
   1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
   2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
   3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
   1. 3/4-inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
   2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
   3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

W. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

X. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service pathway enters a building or structure.
   3. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Z. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC[ and EMT] that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
a. Outdoor Locations Not Exposed to Direct Sunlight: [125 deg F (70 deg C)] temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: [155 deg F (86 deg C) temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: [125 deg F (70 deg C)] temperature change.
d. Attics: [135 deg F (75 deg C)] temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Hooks:
1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.
5. Provide a hook at each change in direction.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [top] of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

END OF SECTION
SECTION 27 05 36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. Ladder cable trays.
   2. Wire-basket cable trays.
   4. Trough cable trays.
   5. Fiberglass cable trays.

B. Related Requirements:
   1. Section 260536 “Cable Trays for Electrical Systems” for cable trays and
      accessories serving electrical systems.

1.03  ACTION SUBMITTALS

A. Product Data: For each type of cable tray.
   1. Include data indicating dimensions and finishes for each type of cable tray
      indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable trays, including plans,
      elevations, and sections of components and attachments to other construction
      elements. Designate components and accessories, including clamps, brackets,
      hanger rods, splice-plate connectors, expansion-joint assemblies, straight
      lengths, and fittings.

C. Delegated-Design Submittal: For seismic restraints.
   1. Seismic-Restraint Details: Signed and sealed by a qualified professional
      engineer, licensed in the state where Project is located, who is responsible for
      their preparation.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.
   3. Detail fabrication, including anchorages and attachments to structure and to
      supported cable trays.

1.04  INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following
   items are shown and coordinated with each other, using input from installers of the items
   involved:
   1. Include scaled cable tray layout and relationships between components and
      adjacent structural, electrical, and mechanical elements.
   2. Vertical and horizontal offsets and transitions.
   3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Component Importance Factor: 1.5.
   3. See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
   1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
   1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
   2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   3. Load and Safety Factors: Applicable to both side rails and rung capacities.
2.03 LADDER CABLE TRAYS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Allied Tube & Conduit; a Tyco International Ltd. Co.
   2. Chalfant Manufacturing Company.
   3. Cooper B-Line, Inc.
   5. MP Husky.
   6. Niedax-Kleinhuis USA, Inc.

C. Description:
   1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
   2. Rung Spacing 9 inches o.c.
   3. Radius-Fitting Rung Spacing: 9 inches at center of tray’s width.
   5. No portion of the rungs shall protrude below the bottom plane of side rails.
   6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
   8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
   9. Width: 12 inches unless otherwise indicated on Drawings.
   11. Class Designation: Comply with NEMA VE 1, Class 12B.
   12. Splicing Assemblies: Bolted type using serrated flange locknuts.
   13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316
   14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 WIRE-BASKET CABLE TRAYS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   1. Allied Tube & Conduit; a Tyco International Ltd. Co.
   2. Cablofil/Legrande.
   4. Cooper B-Line, Inc.
   5. Enduro Systems, Inc.
   7. MP Husky.
   8. Niedax-Kleinhuis USA, Inc.
   10. Wiremaid Products Division; Vutec Corporation.

C. Description:
1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.


4. Sizes:
   a. Straight sections shall be furnished in standard 118-inch lengths.
   b. Wire-Basket Depth: 1-inch usable loading depth by 12 inches wide.
   c. Wire-Basket Depth: 2-inch usable loading depth by 8 inches wide.
   d. Wire-Basket Depth: 4-inch usable loading depth by 24 inches wide.
   e. Wire-Basket Depth: 6-inch usable loading depth by 24 inches wide.

5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.

6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316

2.05 SINGLE-RAIL CABLE TRAYS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Allied Tube & Conduit; a Tyco International Ltd. Co.
   2. Cooper B-Line, Inc.
   4. MP Husky.

C. Description:
   1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
   2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
   3. Rung Spacing 9 inches o.c.
   4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
   5. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
   6. Width: 12 inches unless otherwise indicated on Drawings.
   7. Support Point: Splice fittings shall be hanger support point.
   8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
   9. Loading Depth: 4 inches.
   11. Splicing Assemblies: Bolted type using serrated flange locknuts.
   12. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
   14. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.
2.06 MATERIALS AND FINISHES

A. Steel:
   1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
   2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
   3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
   5. Finish: Electrogalvanized before fabrication.
      a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
      b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
      c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
      d. Hardware: Chromium-zinc plated, ASTM F 1136.
   8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
   9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Aluminum:
   1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
   3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

C. Stainless Steel:
   1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.
   2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.07 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Covers: Solid type made of same materials and with same finishes as cable tray.

C. Barrier Strips: Same materials and finishes as for cable tray.

D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
2.08 WARNING SIGNS

A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.09 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA FG 1.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.

M. Support wire-basket cable trays with center support hangers.

N. Support center support hangers for wire-basket trays with 1/4-inch diameter rods.
O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.

Q. Make changes in direction and elevation using manufacturer’s recommended fittings.

R. Make cable tray connections using manufacturer’s recommended fittings.

S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 “Penetration Firestopping.”

T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

U. Install cable trays with enough workspace to permit access for installing cables.

V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15000 V.

W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 “Grounding and Bonding for Electrical Systems.”

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, “Size of Equipment Grounding Conductors.”

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the
Cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
   2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
   3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
   4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
   5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
   6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
   7. Check for improperly sized or installed bonding jumpers.
   8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
   9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.
   1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for
cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION
SECTION 27 05 44
SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. Sleeves for pathway and cable penetration of non-fire-rated construction walls
      and floors.
   2. Sleeve-seal systems.
   5. Silicone sealants.

1.03  ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2  PRODUCTS

2.01  SLEEVES

A. Wall Sleeves:
   1. Steel Pipe Sleeves:  ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc
      coated, plain ends.
   2. Cast-Iron Pipe Sleeves:  Cast or fabricated "wall pipe," equivalent to ductile-iron
      pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded
   longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves:  ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves:  With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves:  Removable, tapered-cup shaped, and smooth outer surface
   with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and
         with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one
         or more sides larger than 16 inches, thickness shall be 0.138 inch).
2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
   3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   4. Pressure Plates: Carbon steel.
   5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Presealed Systems.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
PART 3  EXECUTION

3.01  SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 “Joint Sealants.”
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.02  SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION
SECTION 27 11 16

COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. 19-inch equipment racks

B. Related Requirements:
   1. Section 270526 - Grounding and Bonding for Communication Systems
   2. Section 270528 - Pathways for Communications Systems
   3. Section 271116 - Communications Racks, Frames, And Enclosures
   4. Section 271513 - Communications Copper Horizontal Cabling

1.2 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.


C. LAN: Local area network.

D. RCDD: Registered communications distribution designer.

E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

F. TGB: Telecommunications grounding bus bar.

G. TMGB: Telecommunications main grounding bus bar.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
   2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer], qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Data: Certificates, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of [RCDD]
   2. Installation Supervision: Installation shall be under direct supervision of [Technician] [Installer 2, Copper or Fiber], who shall be present at all times when Work of this Section is performed at Project site.
   3. Field Inspector: Currently registered by BICSI as [RCDD] [Technician] to perform on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. RoHS compliant.

B. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.2 BACKBOARDS

A. Backboards: Plywood, [fire-retardant treated, ]3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.3 19-INCH EQUIPMENT RACKS

A. Description: four post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch (482.6-mm) equipment mounting with an opening of 17.72-inches (450-mm) between rails.

B. Products: Shall be the following:
   1. Panduit Corp Part #: R4PCN

C. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
   1. Material: Steel
   2. Finish: Manufacturer's standard, baked-polyester powder coat.
3. Color: Black
   Verify options in "Floor-Mounted Racks" Paragraph below with rack manufacturer.

4. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, [and a power strip].

5. Base shall have a minimum of four mounting holes for permanent attachment to floor.

6. Top shall have provisions for attaching to cable tray or ceiling.

7. Self-leveling.

**E. Wall-Mounted Racks:**

1. Height: [18 inches (457.2 mm)] [22 inches (558.8 mm)] [As indicated on Drawings].
2. Depth: [23 inches (584.2 mm)] [29 inches (736.6 mm)].
3. Load Rating: [150 lb (65 kg)] [200 lb (91 kg)].
4. Number of Rack Units per Rack: [8] [12] [22] [As indicated on Drawings].
5. Threads: [10-32] [12-24] [Universal square].
6. Wall Attachment: Four mounting holes.

**F. Vertical Cable Management:**

1. Panduit Part #: WMPVHC45E
2. Dual-sided, ABS Plastic, 45RU, Black, One piece with covers

**G. Horizontal Cable Management**

1. Panduit Part #: WMPF1E
2. 2RMU, black, ABS, Front cover only

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**2.4 POWER STRIPS**

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. [Six] [15-A, 120-V ac, NEMA WD 6, Configuration 5-15R] [20-A, 120-V ac, NEMA WD 6, Configuration 5-20R] receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. [Close-coupled, direct plug-in] [Cord connected with 15-foot (4.5-m)] line cord.
9. Rocker-type on-off switch, illuminated when in on position.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than [330 V]

**2.5 GROUNDING**

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

1. Chatsworth; insert product designation.
2. Leviton Manufacturing Co., Inc.;
3. Panduit Corp;
C. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.
2. Rack-Mounted Horizontal TGB: Designed for mounting in 19- or 23-inch (482.6- or 584.2-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical TGB: 72 or 36 inches (1828.8 or 914.4 mm) long, with stainless-steel or copper-plated hardware for attachment to rack.

2.6 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
4. Adjust configurations 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 equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch. 7.

C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches (50 mm) of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode.
conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.
1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B.

B. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for [Class 2] [Class 3] [Class 4] level of administration, [including optional identification requirements of this standard].

D. Labels shall be machine printed. Type shall [1/4 inch (6 mm)] in height.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Category 6a twisted pair cable.
   3. Cable management system.
   5. Grounding provisions for twisted pair cable.
   6. Source quality control requirements for twisted pair cable.

1.2 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also, commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also, commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.
1.3 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as “Cabling Subsystem 1,” in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
   a. Telecommunications rooms plans and elevations.
   b. Telecommunications pathways.
   c. Telecommunications system access points.
   d. Telecommunications grounding system.
   e. Telecommunications conductor drop locations.
   f. Typical telecommunications details.
   g. Mechanical, electrical, and plumbing systems.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.

B. Product Submittals: For each type of product.

1.6 CLOSEOUT SUBMITTALS

A. Test results in PDF format

B. As-builts
1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of [Technician] [Level 2 Installer], who shall be present at all times when Work of this Section is performed at Project site.
   3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers as well with other trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
   1. Communications, Plenum Rated: Type CMP complying with UL 1685 [or Type CMP in listed plenum communications raceway] [or Type CMP in listed cable routing assembly].
   2. Communications, Non-plenum: Type CMR complying with UL 1666 [and ICEA S-103-701].

B. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
   1. CommScope;
   2. Leviton;
   3. Siemon
   4. TE Connectivity


D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Cable Rating: Plenum.

G. Jacket: Blue.

2.4 CATEGORY 6a TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. CommScope;
   2. Leviton;
   3. Siemon
   4. TE Connectivity

C. Standard: Comply with TIA-568-C.2 for Category 6a cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Cable Rating: Plenum

G. Jacket: Blue.

2.5 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. CommScope/Uniprise;
   2. Leviton/Berk-Tek;
   3. Siemon;
   4. TE Connectivity

C. General Requirements for Twisted Pair Cable Hardware:
   1. Comply with the performance requirements of Category 6 or Category 6a.
   2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
   3. Cables shall be terminated with connecting hardware of same category or higher.
D. Source Limitations: [Obtain twisted pair cable hardware from single source from single manufacturer.] [Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.]

E. Connecting Blocks:
1. 110-style IDC for Category 6.
2. 110-style IDC for Category 6a.
3. Provide blocks for the number of cables terminated on the block, plus [25] <Insert number> percent spare, integral with connector bodies, including plugs and jacks where indicated.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables. Shall be Leviton QuickPort patch panel, Model # 49255-H48 or equivalent.
1. Features:
   a. Labeling areas adjacent to conductors.
   b. Replaceable connectors.
   c. 48 ports.
2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair [cable indicated] [conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria].

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900-mm)
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

H. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
4. Marked to indicate transmission performance.
5. Black in color unless otherwise specified

J. Faceplate:
1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Color shall be: ivory, almond or beige
3. Metal Faceplate: [Stainless steel] [Brass] < complying with requirements in Section 262726 "Wiring Devices.
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks

K. Legend:
1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.
2.6 IDENTIFICATION PRODUCTS
   A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 GROUNDING
   A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
   B. Comply with TIA-607-B.

2.8 SOURCE QUALITY CONTROL
   A. Testing Agency: Engage a qualified testing agency to evaluate cables.
   B. Factory test cables on reels according to TIA-568-C.1.
   C. Factory test twisted pair cables according to TIA-568-C.2.
   D. Cable will be considered defective if it does not pass tests and inspections.
   E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS
   A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters [and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used]. Conceal raceway and cables, except in unfinished spaces.
      1. Install plenum cable in environmental air spaces, including plenum ceilings.
      2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
   B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
   C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS
   A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
   B. Comply with Section 270528 "Pathways for Communications Systems."
   C. Drawings indicate general arrangement of pathways and fittings.
3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:
1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Consolidation points may be used only for making a direct connection to equipment outlets:
   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
   b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.
8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
12. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1524 mm)] apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

   A. Comply with requirements in Section 078413 "Penetration Firestopping."
   B. Comply with TIA-569-D, Annex A, "Firestopping."

3.5 GROUNDING

   A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
   B. Comply with TIA-607-B and NECA/BICSI-607.
   C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
   D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

   A. Identify system components, wiring, and cabling complying with TIA-606-B.
   B. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
   C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
3.7 FIELD QUALITY CONTROL

A. Testing: All installed cables will be certified by an approved cable analyzer.

B. Testing: Test results shall meet TIA-568-C.2 and TIA-568-C.3 requirements.

C. Testing: Test results shall be provided to UNLV Network Development and Engineering as well as UNLV Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all test results prior to activating ports.

D. Tests and Inspections:
   1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2 and TIA-568-C.3. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION
SECTION 28 13 00
SECURITY ACCESS SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Security access devices.
   B. Access control panel.

1.02 RELATED SECTIONS
   A. Section 08 71 00 - Door Hardware.
   B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

1.03 SYSTEM DESCRIPTION
   A. Security Access System: Control access to building and using encoded cards:
      1. All UNLV facility access control systems shall be equipped with the Ilco-Unican
         Marlok Millenium access control system components and hardware. The system
         shall be compatible with the campus Lockshop access control system. All system
         firmware and software must be of the most current version available at time of
         installation. All accessories and components related to building access control
         shall be evaluated for compatibility with the Ilco-Unican Marlok Millenium access
         control system. Systems not compatible with or adaptable for continuous
         operation and monitoring with the Ilco-Unican Marlok Millenium access control
         system will not be accepted or authorized for installation.

   B. Electric Strike Door Locking Systems.

1.04 SUBMITTALS
   A. Submit under provisions of General Conditions.
   B. Shop Drawings: Provide system wiring diagram showing each device and wiring
      connection required.
   C. Product Data: Provide electrical characteristics and connection requirements.
   D. Test Reports: Indicate satisfactory completion of required tests and inspections.
   E. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of
      use stipulated by Product testing agency. Include instructions for storage, handling,
      protection, examination, preparation, installation, and starting of Product.

1.05 QUALITY ASSURANCE
   A. Perform work in accordance with NECA Standard of Installation.
   B. Maintain one copy of each reference document on site.
1.06 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of General Conditions.
   B. Record actual locations of access authorization equipment.

1.07 OPERATION AND MAINTENANCE DATA
   A. Submit under provisions of General Conditions.
   B. Operation Data: Operating instructions.
   C. Maintenance Data: Maintenance and repair procedures.

1.08 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
   B. Installer: Company specializing in installing the Products specified in this section with minimum three years documented experience.

1.09 REGULATORY REQUIREMENTS
   A. Conform to requirements of NFPA 70.
   B. Furnish Products listed and classified by UL as suitable for purpose specified and indicated.

1.10 MAINTENANCE SERVICE
   A. Furnish service and maintenance of security access system for one year from Date of Substantial Completion. Provide a service agreement to owner for service after one year.

1.11 EXTRA MATERIALS
   A. Furnish under provisions of General Conditions.
   B. Provide 500 key cards.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Marlock.
   C. Do not substitute manufacturers.

2.02 SECURITY ACCESS CONTROL EQUIPMENT
   A. Provide all components and materials required for a complete and operable system.
   B. Provide complete protection from weather in a factory approved manner for equipment located outdoors.
C. Marlock Door Control Device.
D. Marlock Battery Back Up - Provide with batteries.
E. Marlock Relay Control Device.
G. Marlock Site Control.
H. Marlock Modem Lease Line.
I. Marlock RS232 Port Splitter.
J. Panic Bar - Securitron TSB-1.
K. Time Delay Module - Securitron SN-TDMT-12.
M. Battery - Securitron 4A-NP712.
N. Door Contacts - Securitron 1048W.
O. See drawings for location of equipment.

PART 3
EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Use 16 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in conduit.
C. Make conduit and wiring connections to door hardware devices furnished and installed under Section 08 71 00.

3.02 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed under provisions of General Conditions.

3.03 MANUFACTURER'S FIELD SERVICES
A. Provide manufacturer's field services under provisions of General Conditions.
B. Include services of technician to supervise installation, adjustments, final connections, system testing, and training Owner's personnel.

3.04 DEMONSTRATION
A. Provide systems demonstration under provisions of General Conditions.
B. Demonstrate normal and abnormal modes of operation, and required response to each.
C. Training: Provide onsite training of security system. Coordinate with UNLV Security Department and UNLV lockshop.

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1. **PART I - GENERAL**

1.0. **PURPOSE**

The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV’s requirements in excess of ten years.

Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.

1.1. **CONTRACTOR QUALIFICATIONS**

Contractor must possess a valid State of Nevada Contractor’s License and have successfully performed at least three projects of low voltage cable installation with similar size and work scope, within two years of the date of the job they are bidding on. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the start and end dates, and contact information. For projects that require a Request for Proposal this information will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

All contractor personnel who will be performing work on this project shall have been trained on the work they will be performing. They shall have been trained on the Contractor’s company policies with respect to personnel safety, telecommunications industry cabling quality and neatness standards, and use of Construction Standard Institute (CSI)-standard specifications and drawings.

Contractor, at all times during performance and until work is completed and accepted, shall have on the premises a competent supervisor, satisfactory to the Customer and with authority to act for the Contractor. The supervisor must be a BICSI certified Installer and BICSI member in good standing.
As a requirement to bidding and performing awarded work, the Contractor must have a current BICSI certified Registered Communications Distribution Designer (RCDD) on staff, either as a full-time employee or as a hired consultant. At UNLV’s discretion, on a project-by-project basis, a RCDD consultant may be hired by the university to inspect work during and after completion. In these cases, the RCDD requirement will be met by the university and the Contractor will not be required to have a RCDD on staff. Based upon the inspection by UNLV’s hired RCDD consultant or Network Development & Engineering (NDE) staff the Contractor will be responsible for correcting any work that does not meet requirements detailed in this document.

For projects that require a Request for Proposal the RCDD certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

For jobs that require more than 24 data connections, weekly inspections and approval of all work performed shall be conducted by the contractor’s RCDD certified employee. The contractor will submit a weekly status report to the Customer detailing what work has been completed and inspected. The report will also include any issues encountered as part of the install. See Appendix A5 for report template.

Contractor must provide at least one lead technician on site at all times during project who is a BICSI certified installer and a BICSI member in good standing. For projects that require a Request for Proposal a copy of certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request must be provided with bidding documents.

1.2. APPLICABLE REGULATIONS

A. RELATED DOCUMENTS

Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency.

1. ANSI/TIA-569-D Telecommunications Pathways and Spaces
2. ANSI/TIA 568-D.0 Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568-D.1 Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling
and Components Standard
5. ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard
6. ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure
7. ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling National Electrical Manufacturers Association (NEMA)
9. National Electrical Code, latest revision (NEC)
10. National Fire Protection Agency (NFPA) – 70
11. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
12. UL 497 Protectors
13. UL 1459 Standard for Safety for Telephone Equipment
14. UL 1863 Standard for Safety for Communications Circuit Accessories
15. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
17. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
19. ANSI/EIA 310D

1.3. **SUBMITTAL**

For jobs that require submittals, the Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer:

1. Contractor’s license number and proof of qualifications.
2. A copy of the RCDD certificate and BICSI member number as described in the above Contractor Qualifications section.
3. A copy of the BICSI certificate and the BICSI member number of the lead technician as described in the above Contractor Qualifications section.
4. A copy of the BICSI certificate and the BICSI member number of the supervisor as described in the above Contractor Qualifications section.
5. For all Category 6A and 6 installation technicians, provide the training certificates with a brief description of the training courses associated with each certificate.
6. Reference sheets which provide three references. Each reference shall include a brief description of the project, the start and end dates, and contact information.
7. A copy of a valid manufacturer certified installer certification.
8. The make and model of the materials to be used.

1.4. **DESIGN REQUIREMENTS**

Work must conform to the design requirement for each identified element.
A. BUILDING SERVICE

Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for an air-blown fiber tube-cell conduit to enter through individual 4” conduits from the campus underground plant from two diverse locations. Exact air-blown fiber tube-cell conduit size will be determined by Network Development and Engineering on project by project basis. Voice cables (minimum 50 pair) to enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4” conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4” above finished floor in the MDF (main distribution frame) room inside the building.

1. Service – Data

Data communication service to each building shall consist of a minimum of 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own air-blown fiber tube-cell conduit. Multi-mode and single-mode fiber is to be terminated with LC style connectors, UPC. Single-mode fiber will be terminated in a separate rack-mounted fiber optic enclosure. Contractor will install an air-blown fiber distribution unit in all MDF and IDF locations. Each fiber optic enclosure must be labeled with building, IDF room number and fiber enclosure identifier of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. Service loops of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.

2. Service – Voice

Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50-pair twisted cable. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.
B. SERVICE ENTRIES

Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range.

Building entry conduit shall allow for 50% growth and have a minimum of four 4” conduits from manhole to MDF room.

C. MANHOLES

All manholes shall be at minimum 4’ by 4’ by 4’ and encased in concrete. All cable is to have service loops and be racked and mounted. Each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas, or 6” above finished grade in landscaped areas.

D. CABLE SPLICING

Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtails. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable.

The following cable splicing techniques and materials for copper cable shall be utilized:

1. Preparation for Splices
   - All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcast 4435 non-conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcast 4414 or 4415 or UNLV approved equal.

2. Splicing requirements
   a. No splice cases will be permitted in cable trays.
   b. All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
   c. End caps must be tapered and flexible and be capable of separate cable entries.
   d. Rigid bonding and strain relief bars must be an integral part of the finished closure.
   e. Re-enterable, polyurethane compound shall be used.
   f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
   g. Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand
RC-100 rack adapters, manhole racks, or University approved equivalent.
h. Closures: 3M splice closures or University approved closures will be used for splicing throughout the system.
i. Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcast Pair Saver 4458 or approved equivalent.

E. BUILDING VOICE AND DATA TERMINAL ROOMS

All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications
   a. The MDFs shall **not contain any equipment not specified by UNLV Network Development and Engineering**. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.
   b. Each MDF will be provided with an isolated electrical panel with 200-amp service.
   c. The MDF will require the installation of a telecommunications main grounding busbar (TMGB) to the service equipment (power) ground with a conductor the same size as the largest telecommunications bonding backbone (TBB). The connections of the bonding conductor for telecommunications (BCT) and the TBB to the TMGB shall utilize exothermic weld, Listed compression two-hole lugs, or two-hole exothermic lugs. All equipment racks shall be connected to the TGB with a telecommunications equipment bonding conductor (TEBC) that is continuous copper conductor not less than #6 AWG.

   The TMGB shall:
   - Be provided with holes for use with correctly matched listed lugs and hardware.
   - Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
   - Have minimum dimensions of ¼ in. (6.35mm) thick by 4 in. (100mm) wide and shall be long enough to accept all current connections with additional room for growth.
   - Be Listed by authority having jurisdiction.
   d. Each MDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs, two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs, and two 20 amp NEMA L6-20Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or
otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks at standard outlet height.

e. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36” wide and 80” high.

f. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14’ x 10’, and not have false floors or ceilings.

g. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

h. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

i. All MDFs shall be secured using a UNLV-approved card access reader and striker.

j. All MDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of two walls must be covered by backboards as defined in Part II.

m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

2. Intermediate Distribution Facilities (IDFs)

a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.

b. Each IDF will be provided with a TGB connected by a TBB to the TMGB. The TBB shall be no smaller that a #6 AWG conductor and/or use the recommend sizes in accordance with ANSI-TIA-607-B. All equipment racks shall be connected to the TGB with a TEBC that is continuous copper conductor not less than #6 AWG. The TGB shall:
   - Be provided with holes for use with correctly matched listed lugs and hardware.
• Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
• Have minimum dimensions of ¼ in. (6.35 mm) thick by 2 in. (50.8mm) wide and shall be long enough to accept all current connections with additional room for growth.
• Be Listed by authority having jurisdiction.
• Where a grounding equalizer (GE) is required it shall be bonded to the TGB.

c. Each IDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, at standard outlet height.

d. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36” wide and 80” high.

e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8’ x 10’, and not have false floors or ceilings.

f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

g. A separate HVAC thermostat control will be installed for all IDF rooms, and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

h. All IDFs shall be secured using a UNLV-approved card access reader and striker, the access of which is to be managed by the Network Operations Center.

i. All IDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.

j. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of two walls must be covered by backboards as defined in Part II.
m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

F. BUILDING INTERIORS

1. Underground Plant
   a. The cables from the underground plant shall enter the building in a MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and hook and loop tape so as not to exceed the acceptable cable bend radius.

2. Data Rooms
   a. Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.

3. Internal Backbones (Risers)
   a. A minimum of two 4” conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of single-mode fiber, as defined in Part II. Fiber optic cable is to be contained inside air-blown tube cell conduit. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring
   a. Data Outlets
      • All outlets shall be constructed using single gang, 4-port faceplates, colored almond, or similar. All outlets shall have at least two network drops each.
      • The ports on the left side of the faceplates will always correlate to an odd numbered patch panel port. The ports on the right side of the faceplates will always correlate to an even numbered patch panel port.
   b. Copper Cabling
      • All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate
in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.

c. Habitable Space Provisioning

- Every habitable space shall be provisioned a minimum of one data outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.

d. Non-habitable Space Provisioning

- Every non-habitable space shall be provisioned with one data outlet every 500 ft², minimum of 1 per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

e. Labeling

The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall match the corresponding patch panel port number for each drop. The drops will be in consecutive order whenever possible. They shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer’s labels provided with the outlet assembly unless otherwise specified. The labeling schema shall be as follows:

- All labels will be in the format of "310-306-1-24" Where "310" is the Station room number, “306” is the IDF, "1" is the Patch Panel identifier, and "24" is the port that the drop terminates to in the patch panel.

- Cable Wrap labels:

Wrap labels are required within 6 inches of the cable's termination point at both ends. Wrap labels will follow the format listed in this section, i.e. "310-306-1-24" Splitting this into two lines is acceptable in which case "310-306" would go on the first line and "1-24" would go on the second line. The font size will be the largest size that fits the required information but no smaller than 8 point font.
Station labels:

The Station label will follow the format listed in this section. However, the top label include both top ports i.e. "310-306-1-24,25". The first patch panel port number will always be the left face plate port and the second patch panel port number will always be the right face plate port. The bottom label will follow the same guidelines when used. When unused the label will be left blank. The font size will be the largest size that fits the required information but no smaller than 10 point font. See “Standard Outlet Configuration” in Appendix A2

Data Room Patch Panel:

The patch panel identifier will be labeled by the installer on the left side of the patch panel in a place that is easily visible. Counting from the top of the rack down, the first installed patch panel will be identified with the number 1, the second with the number 2 and so on.

The patch panel port label will be in the format listed above "310-306-1-24". Space limitations will require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8 point font. These labels should be center justified and located directly above the port they are labeling or in other manufacturer provided locations for port labels.

5. Wireless – 802.11
   a. Data cabling at wireless locations shall be terminated in electrical boxes that are mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall be directly run from an IDF and will be terminated in data jacks. The jacks will be mounted in a faceplate and the faceplate will be mounted to the electrical box. For existing buildings the contractor will provide a minimum of 5 feet of data cabling service loop at the electrical box. For new buildings, the contractor will provide a minimum of 20 feet of data cabling service loop at the electrical box.
   b. Electrical boxes used for wireless AP installations shall have a minimum clearance of 14” x 14” x 8” and will be mounted to a wall or secured to equipment that meets local NEC, ANSI/TIA-568-C, and ANSI/TIA-569-C standards. No cable run from IDF to connection point may exceed 300 feet.
   c. At each access point location, connect the access point to the horizontal cabling using contractor provided patch cords (see section 2.2.B for patch cable requirements). The cable that correlates to an odd numbered patch panel port will plug into the access point’s LAN port and the cable that correlates to an even numbered patch panel port
will plug into the access point’s CONSOLE port. All patch cables will use appropriate J-hook/supports or dressing.
d. Wireless locations that are placed in locations with a hard-lid ceiling will have the cables be terminated inside of the electrical box but not placed in a faceplate. The electrical boxes at these locations shall be 4 inch square boxes with a depth of 3 ¼, or 5-inch square boxes. Each box must maintain the minimum bend radius of the cable.
e. Access point installations other than hard-lid locations will require the Contractor to use a Customer provided bracket. This might require the Contractor to cut a hole in drop ceiling acoustic tile. See Appendix A4 for an example of this install.
f. For new buildings only, the Contractor will be required to move the APs and electrical boxes utilizing the service loop as required after the Customer completes a wireless survey.

6. Wireless Access Point Placement and Wireless Overlay for 802.11

Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:
a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
b. Installations which require access points to use antennae other than the standard dipole antennae
c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays

All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.

a. Supports
   Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2” in diameter.

b. Capacity
   Cable trays shall be sized for a minimum growth of 50%.

c. Grounding
   Cable trays shall be grounded in accordance ANSI/TIA-607-B.
8. Cable Installation
   a. Copper
      Installation is to meet or exceed ANSI/EIA/TIA 568-C and
      ANSI/EIA/TIA 569-C.

      All terminations are to follow ANSI/EIA/TIA 568-B.

      Completed installation is to be Certified Category 6 or 6A using the
      ANSI/EIA/TIA 568-C.2 testing standard or better. Test
      documents/results to be supplied to UNLV in .PDF format. Completed
      installation is to be approved by UNLV Network Development and
      Engineering.

   b. Fiber
      Installation is to meet or exceed ANSI/EIA/TIA 568-C and
      ANSI/EIA/TIA 569-C. Fiber terminations will be completed using one
      of the following methods:

      - No epoxy/no polish connectors
      - Factory-terminated pigtails with fusion splicing

      Single-mode will be terminated in a separate rack-mounted fiber optic
      enclosure.

      Completed installation is to be certified using ANSI/EIA/TIA 568-C.3
      testing standard or better. Test documents/results to be supplied to
      UNLV in .PDF format. Completed installation is to be approved by
      UNLV Network Development and Engineering.

9. Pull and Splice Boxes
   a. Location
      Pull boxes must be installed in easily accessible locations. It is not
      permissible to locate a pull box in the ceiling for conduits larger than
      2” in diameter. Conduits larger than 2” diameter, entering a box shall
      be routed down a wall or column and the box shall be installed
      accordingly.

      All pull boxes shall be placed in a straight section of conduit. Align the
      corresponding conduits at each end. All boxes shall be properly and
      adequately secured. They are not to be supported by the conduits
      entering the box. Install boxes for station cabling immediately above
      the suspended ceiling.

   b. Access
      Provide boxes with a suitable cover.
G. GROUNDING

1. Regulations
   All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC), ANSI/TIA-607-B, and all other applicable codes and regulations.

2. Installation Requirements
   Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.

3. Grounded Connectors
   Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas or water pipe as the grounding electrode.

2. PART II – PRODUCTS AND ACCEPTED MATERIALS

2.0. GENERAL
   All material required for a complete installation shall be furnished by the Contractor unless otherwise specified by UNLV Planning and Construction Department.

   All materials provided by the Contractor must be new, free from defects and must meet the Customer’s specifications. A parts list for the approved manufacturers can be found in Appendix A6. For projects that require a Request for Proposal, bidders shall submit the make and model of materials that will be used as part of their submittal. See section 1.3.

   All fixtures and hardware must be installed as per requirements detailed in this document. No custom items shall be used except as reviewed and approved by NDE. The contractor shall be held financially responsible for any work or re-work required due to improper approval and/or acceptance of that work performed which differs from the construction documents.

   All products shall be new, and brought to the job site in original manufacturer’s packaging. Electrical components (including innerduct) shall bear the
Underwriter’s Laboratories label

All station cables shall be CMR Riser rated when entire cable runs are installed in conduit and cable tray.

All station cables shall be CMP Plenum rated when any section of the cable run is not installed in conduit.

The Contractor shall inspect all products and materials prior to installation. Damaged cable or any other components failing to meet specifications shall not be used in installation.

2.1. BACKBOARDS
All backboards required in the IDF/MDF rooms shall be plywood, ¾”, 4’ by 8’ sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed.

2.2. CABLE SPECIFICATIONS

A. WARRANTY
All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. Vendors must be certified installers of the products they select for installation. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

B. APPROVED CABLEING MANUFACTURERS

1. Copper Installation:
Vendors may select from the following list of approved copper cabling manufacturers:

Commscope
Leviton
Siemon
TE Connectivity

Products selected from these vendors must meet requirements detailed in this document.

a. New Building
All copper installations in new buildings on campus will be completed using products from a manufacturer on the approved list. All cabling and components will be certified Category 6A / Class Ea and will meet all requirements listed Section 2.2-C.
b. Existing Building

In cases where vendors install cabling in existing IDF s, installers shall use open ports on existing category 6 patch panels. The warranty requirement listed in section 2.1-A will apply to these installations. This will require vendors to be certified installers for the existing components in the IDF. If there are no open ports, not enough ports to complete the job, the existing patch panel is not category 6, or the installer is not a certified installer of the existing components, the contractor will use a Leviton QuickPort patch panel, (Model number 49255-H48) or equivalent that has been viewed, tested and approved by Network Development and Engineering staff. The installer shall use authorized products that they are certified to install from a manufacturer on the approved list in Appendix A6.

5. Fiber Installations:

Vendors may select from the following list of approved air-blown fiber cabling solution manufacturers where air-blown fiber is required:

Future Flex Air-Blown Network Solutions by Sumitomo Electric
Lightwave
eABF solutions by AFL/Duraline

Vendors may select from the following list of approved fiber cabling solution manufacturers where Air-Blown Fiber is not required:

AFL
TE Connectivity
Siemon
Leviton
Commscope
Corning

Products selected from these vendors must meet requirements detailed in this document.

a. Building to Building

- All fiber installations for building to building interconnects will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.

b. New Building

- All fiber installations for new buildings on campus, including building to building interconnects and MDF to IDF connections will use air-blown fiber solutions. Contractors shall install
components from a manufacturer on the approved air-blown fiber manufacturer list.

c. Existing Building
   • All fiber installations for buildings with existing air-blown fiber infrastructure will be installed using use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
   • All fiber installations for buildings without existing air-blown fiber infrastructure will be installed using traditional fiber cabling. Contractors shall install components from a manufacturer on the approved fiber manufacturer list.

C. DATA COPPER
   All copper data cable for existing buildings will be Category 6, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6/Class E requirements. All copper data cable for new buildings will be Category 6A, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6A/Class F requirements. Only materials from accepted manufacturers in section 2.1.B will be installed. Cables will be rated as plenum or riser based on installation requirements.

D. PATCH CABLES
   All patch cables installed by the contractor will be factory terminated and tested to meet requirements stated in section 2.2.C.

E. EXTERIOR CABLE
   All telephone cable that supports devices external of a building such as emergency phones use Superior Essex cable part number 09-092-02, 6 pair buried drop.

F. SINGLE-MODE FIBER OPTIC
   All single-mode fiber optic cable must be 9.0/125. All single-mode terminations are to be LC, UPC finish. A 12- or 24-fiber adapter panel must be used in the fiber optic enclosure.

G. AIR-BLOWN FIBER COMPONENTS
   Tube cell count for tube-cell cabling will be determined by Network Engineering and Development Staff on a project by project basis.

   All new building IDF's and MDF's will require the installation of fiber distribution boxes. Other locations such as manholes and other splice or junction locations will require fiber distribution boxes as needed.
2.3. DATA TERMINATIONS

A. COPPER DATA COMPONENTS

1. Patch Panels
   All data patch panels for existing buildings are to be a Leviton QuickPort patch panel, (Model number 49255-H48) or equivalent, that has been viewed, tested and approved by Network Development and Engineering staff. Equivalent patch panels must accept keystone Category 6 or 6A jacks, in 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class F requirements. They must also be capable of housing keystone data jacks from other manufacturers, be viewed, tested and approved by Network Development and Engineering staff.

   Every group of 48 must be separated by 2U of horizontal cable management, Panduit part# WMPF1E. All cabling will route through the rear cable management prior to termination in the patch panel. All terminations are to follow ANSI/EIA/TIA 568-B.

2. Voice Copper Termination Blocks
   All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.

3. Data Jacks
   All data jacks for existing buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. Data jacks must be compatible with patch panel from Section 2.3.A.1. Compatible jacks are listed in Appendix A6, in each manufacturer section, item description “Jacks – Universal, Black”.

   All data jacks for new buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class Ea requirements.

   All terminations are to follow ANSI/EIA/TIA 568-B.

4. Faceplates
   All faceplates shall be 4 port, light almond (or vendor equivalent), single gang, low profile, with a window for labels. All unused ports must be covered with a blank insert.

B. FIBER OPTIC

   a. Terminations
Terminations will be completed with one of the two following methods:
- No epoxy/no polish connectors
- Factory-terminated pigtails with fusion splicing
Fusion splices will be protected in splice cases or other suitable enclosures.

b. Connectors
Single-mode fiber is to be terminated with LC style connectors, UPC Polish.

c. Fiber enclosures
TE Connectivity fiber optic enclosures models RMG-2000-000B or RMG-4000-000B will be used. RMG-4000-000B will be used when installing more than 24 fiber strands or at the request of network engineering. RMG-2000-000B will be used when installing 24 fiber strands or less. Equivalent enclosures can be approved by Network Development and Engineering on a case-by-case basis.

d. Fiber Adapter Panels
Single-mode fiber will terminate in 12- or 24-fiber standard adapter panels.

2.4. DATA EQUIPMENT RACKS
All racks are to be four post, open frame, square hole, black, Panduit part number R4PCN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.5. CABLE TRAYS
All cable trays for distribution of data cables within a building are to be a minimum of 18” wide by 4” deep, solid trough or ladder and will be approved by UNLV Planning and Construction and Network Development and Engineering.

2.6. EXCEPTIONS
Due to unique constraints and requirements of existing IDF's, exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

3. PART III – EXECUTION
The University has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the University to inspect certain material or
work, shall mean that the University has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.1. DEMOLITION

A. COORDINATION WITH UNIVERSITY OPERATIONS

No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. WORK TO BE PERFORMED BY OWNER

Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will ensure that all cross-connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. DISPOSAL OF SURFACE-MOUNT RACEWAY

Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.2. EXCAVATION

The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The University has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor’s expense.

Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

All underground construction work, during progress and after completion, shall conform truly to lines and grades.
If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.

Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

Grass will be replaced by a method approved by the University.

Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.3. INSTALLATION

A. REGULATIONS

All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the vendor will correct the deficiency at no cost to the University.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. QUALITY ASSURANCE

Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.
C. DAMAGE OF EXISTING FACILITIES

The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. COORDINATION

Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by University personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. CABLE SUPPORT AND ANCHORS

All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.

All data cables installed without conduit in plenum spaces will be secured using j-hooks or other Network Development and Engineering approved mounting hardware.

F. FIRESTOP SYSTEMS

A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:
2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
3. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops
4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
6. UL 263: Fire Tests of Building Construction Materials
7. UL 723: Surface Burning Characteristics of Building Materials
8. UL 1479: Fire Tests of Through Penetration Firestops

G. CONDUIT

1. Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.

2. Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.

3. All offsets shall be considered equivalent to a 90-degree bend.

4. Sections of conduit longer than 100 ft. require a pull box.

5. Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.

6. Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.

7. Conduits entering the IDF from below shall be terminated 4 inches above finished floor.

8. Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4” in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

9. Conduit installed for data and/or voice cabling may not be shared with any other cable.

10. All conduit runs for station outlets shall be not less than 1” in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
11. After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.

12. Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.

13. Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8" in diameter.

14. Conduit shall not block access to existing services.

15. All junction boxes will maintain the minimum bend radius for the cable being installed. Special consideration should be taken concerning the use of Category 6A/Type E_A cabling, data termination jacks, and the minimum bend radius with required eight (8) inch minimum excess cable at each outlet.

16. Pull boxes will be installed in position and relationship to adjoining work, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

H. CABLE INSTALLATION

1. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

2. Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.

3. All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.

4. All data outlets will have a minimum of eight (8) inches of cable stored at each drop after the cable has been terminated.

5. All data cabling will have a service loop with a minimum of 5 feet of data cabling that will be placed on the MDF/IDF ladder rack.

6. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
7. All cabling in an open ceiling and/or open-plenum space will be ran in conduit or cable tray.

8. Cable supports are to be anchored in accordance with TIA 569-C and NEC.

9. Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.

10. All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.

11. Hook and loop tape is the only approved product for bundling cable. Tie-wraps will not be used bundle cable.

12. Installation to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. UNLV Network Development and Engineering must approve completed installation.

I. CABLE TESTING

All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Copper Data Cable

All Data cables shall be tested in accordance with ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard or better and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.

a. Testing

Each cable shall be tested for wire map, length and performance. The data cables shall be bi-directional tested using an ANSI/TIA 1152 level III or better cable analyzer. The cable analyzer shall be within the calibration period recommended by the manufacturer.

- Wire Map

Each pair of each installed cable shall be tested for continuity, opens, shorts, pair-reversals, split pairs, transposed pairs, and any other miss-wiring. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable
identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

- **Length**
  Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

- **Performance Verification**
  Category 6 or 6A data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:

  1. Propagation Delay
  2. Delay Skew
  3. Insertion Loss
  4. NEXT (Near-End Crosstalk)
  5. PS NEXT (Power Sum Near-End Crosstalk)
  6. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
  7. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
  8. ACR-F (Attenuation to Crosstalk Ratio Far-End)
  9. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
  10. Return Loss
  11. TCL (Transverse Conversion Loss) – recorded for information only
  12. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only

- **Equipment**
  Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C.2 Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network...
Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. **Fiber Optic**

Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C3 Standard, and the result shown as pass/fail. The test results shall include all tests performed and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-C.3, Optical Fiber Cabling Components.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor’s test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

a. **Single-mode**

Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss.
of the install cable plus two patch cords. Single-mode fiber optic cable must meet or exceed the following limits:

- **Attenuation**
  0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
- **Connectors**
  Max loss for a mated pair of connectors shall be less than 0.5dB

3. **OTDR**
Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with ANSI/TIA 568-C.2. The measurements to determine splice loss shall be performed in accordance with manufacturer’s recommendations and best industry practices.

4. **As-Buils**
All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and its corresponding station side location. As-buils will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-buils & test results must be provided in both .PDF and CAD format. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-buils & test results and subsequent corrected versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

**J. GROUND TESTING**
Two-point ground and continuity testing will be performed to determine if there is an acceptable maximum level of resistance between any point in the telecommunications bonding and grounding system and the building’s electrical grounding electrode system.

a. Prior to performing a two-point test, a visual inspection shall be performed to verify the bonding and grounding system is installed according to ANSI/TIA-607-B guidelines.

b. For the test to be valid it must be done prior to the installation of the telecommunications equipment.

c. The recommended maximum value for resistance between any point is 100 milliohms.

d. The following areas will be tested:

e. TMGB/TBG to the electrical ground from each IDF/MDF.

f. TMGB/TGB to the building steel (if present).

g. TMGB to TGB
h. Building steel (if present) to the electrical ground.
i. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project.
4. **CONTRACTOR SUMMARY**

This summary is intended to provide an overview of key requirements that contractors of small data cabling installations will most often need to reference. Contractors will still be responsible for maintaining compliance with the entire wiring specification.

A. Contractor requirements
   1. Certified to install for one of the approved manufacturers.
   2. RCDD on staff
   3. Supervisor and/or lead installer shall be BCSI certified installers and members in good standing
   4. For required installations, RCDD will conduct weekly inspections and submit weekly status report to Customer.

B. Approved manufacturers
   1. Copper
      a. Commscope/Uniprise
      b. Leviton/Berktek
      c. Siemon
      d. TE Connectivity
   2. Fiber
      a. Air-blown fiber
         - Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
         - eABF solutions by AFL/Duraline
      b. Non-air-blown fiber
         - Corning
         - TE Connectivity
         - Siemon
         - Leviton
         - Commscope

C. Warranty
   1. All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

D. Cabling
   1. Copper Data Cabling and Components
      a. New buildings will be installed with Category 6A cable and components from one of the approved manufacturer’s parts in Appendix A6.
      b. Existing building will be installed with Category 6 cable and components from one of the approved manufacturer’s parts in Appendix A6.
      c. All data cabling will have a service loop with a minimum of 5 feet of data cabling that will be placed on the MDF/IDF ladder rack.
d. All data patch panels for existing buildings are to be Leviton QuickPort patch panel, (Model number 49255-H48). Equivalent patch panels must accept keystone Category 6 or 6A jacks, in 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class F requirements. They must also be capable of housing keystone data jacks from other manufacturers, be viewed, tested and approved by Network Development and Engineering staff.

e. All data jacks shall be modular, unshielded, 4-pair, 8P8C, Category 6 or 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class F requirements. Data jacks must be compatible with patch panel from Section 2.3.A.1. Compatible jacks are listed in Appendix A6, in each manufacturer section, item description “Jacks – Universal, Black”.

f. Terminations will follow wiring scheme TIA568-B.

g. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.

h. Hook and loop tape is the only approved product for bundling cable. Tie-wraps will not be used bundle cable.

i. Wire managers will be Panduit WMPF1E and WMPVHC45E

j. Racks will be Panduit R4PCN

k. Installations must comply with TIA 569-C and TIA568-C.2

2. Fiber Cabling and Components

a. Air-blown fiber tube cell conduit will be installed in all new buildings and in new building-to-building fiber installations.

b. Air-blown fiber will be used in existing buildings that contain existing air-blown fiber components.

c. Non-air-blown fiber will be used in existing buildings that do not have existing air-blown fiber components.

d. Terminations will be completed using no epoxy/no polish connectors or factory-terminated pigtails with fusion splicing.

e. All fiber will be terminated with LC / UPC connectors and be mounted in 12- or 24- fiber adapter plates.

f. Fiber enclosures will be from a NDE-approved manufacturer. Adapter plates will of standard size and will fit these enclosures.

E. Documentation

1. Labeling

a. Contractor will be responsible for labeling all installed cables.

   • The labeling scheme will use the format described in Appendix A2.

   • Contractor will label the patch panel port, cable termination points, and faceplates.

   • Contractor will also be responsible for labeling any new patch panel.
2. Testing
   a. All installed cables will be certified by an approved cable analyzer. Test results will meet TIA-568-C.2 and TIA-568-C.3 requirements. Test results will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all test results prior to activating ports.

3. As-builts
   All installed cables will be documented on an as-built diagram. The diagram will indicate the location and actual label of all installed cabling. As-builts will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all that the data contained the as-builts matches the actual labels prior to activating ports.
APPENDIX A – EXHIBITS

A1 Standard Conduit Routing

PLAN VIEW

ELEVATION VIEW

1 90 degree bend

1 Inch Conduit

FASTENED TO CABLE TRAY WITH BUSHING

Single Gang Box
1” conduit to cable tray

CABLE TRAY

STATION BOXES
A2 Standard Labeling Scheme

**Faceplate Label:**
Follows format of Room#-IDF#-patch panel#-1st port#, 2nd port

The cable run of this jack is terminated at patch panel 5, port number 13 at IDF 305 and in room 310

**Wrap Label:**
Required within six inches of both termination points

Preferred: 310-305
5-13

Acceptable alternate: 310
305
5-13

**Conduit:**
3/4" Diameter

**Data Jacks:**
Cat6, 8P8C, Black

**Blank Inserts:**
Match faceplate color

**Bottom Faceplate Label:**
Left blank unless bottom ports are used. If used, the bottom label will follow the top label's format for 3rd and 4th ports

**Patch Panel Labels:**
Each patch panel port will be labeled as shown using the scheme listed above

Patch panels will be labeled as shown. The label will be a number unique to the rack. If it is the top patch panel in the rack it will be labeled 1. If it is the next patch panel down from the top it will be labeled 2 and so on.
A3 As-Built Example

Legend
- Data Wall Outlet
- Data/Voice Wall Outlet
- Data Ceiling Outlet
- Data Floor Outlet

IDF 103
112-103-2-03,04
111-103-2-01,02
117-103-2-05,06
130-131-1-01,02
130-131-1-03,04
IDF 131
Example access point acoustic tile install

AP bridges tile rails so fully supported

Screw locks bracket to rail
### UNLV Network Engineering Cabling Weekly Report

**Contractor:**
_______________________________________

**Inspected By:**
_______________________________________

**Project Name:**
_______________________________________

**Date:** ___/___/_____

1. **What is the estimated project completion status?** _____ %

2. **List any problems encountered during the review period and their resolution**

   __________________________________________________________

   __________________________________________________________

   __________________________________________________________

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   __________________________________________________________

3. **List rooms and/or portions of the project that were inspected during the review period**

   __________________________________________________________

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## A6  Approved Copper Manufacturer’s Parts List

### A. CommScope / Uniprise

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model Number</th>
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<tr>
<td><strong>Category-6 (CAT-6) Products</strong></td>
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<tr>
<td>Cabling – 1000 ft bulk, Plenum</td>
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<tr>
<td>Cabling – 1000 ft bulk, Riser</td>
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### B. Leviton / Berktek

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**D. TE Connectivity**

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