SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Selective demolition of existing building elements to prepare for new construction.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate utility and building service interruptions with Owner.

1. Notify Owner seven days, minimum, before disrupting building fire protection and life safety systems.
2. Schedule tie-ins to existing systems to minimize disruption.
3. Coordinate Work so fire protection and life safety systems remain continuously operational in occupied areas.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

C. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.

D. Schedule Work to coincide with new construction.

E. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation and occupancy of adjoining spaces.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Indicate demolition sequence.
2. Indicate location of items designated for reuse or Owner's retention.
3. Indicate location and construction of temporary partitions.

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.

1.5 FIELD CONDITIONS

A. Conduct demolition to minimize interference with adjacent building areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Comply with the following reference standards:

1. ANSI/ASSP A10.6.
2. NFPA 241.

B. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.

C. Perform Work in accordance with State of New Jersey standard.

3.2 PREPARATION

A. Notify affected utility companies before starting work; comply with requirements.

B. Mark location and termination of utilities.

C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public and the Owner.

D. Erect and maintain weatherproof closures for exterior openings.

E. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

F. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.

G. Provide appropriate temporary signage including signage for exit or building egress.

H. Do not close or obstruct building egress paths.

3.3 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove building components and equipment indicated to be salvaged.

E. Disassemble as required to permit removal from building.

F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.4 DEMOLITION

A. Conduct demolition to minimize interference with adjacent building areas.

B. Maintain protected egress from and access to adjacent existing buildings at all times.

C. Do not close or obstruct roadways or sidewalks without permits.

D. Disconnect and remove designated utilities within demolition areas.

E. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

F. Demolish in orderly and careful manner. Protect existing improvements.

G. Carefully remove building components indicated to be reused.

1. Disassemble components as required to permit removal.
2. Package small and loose parts to avoid loss.
3. Mark components and packaged parts to permit reinstallation.

4. Store components, protected from construction operations, until reinstalled.

H. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

I. Transport friable and dusty demolished materials through building in enclosed containers.

J. Remove materials as Work progresses.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Load-bearing CMU walls

B. Principal Products:

1. Concrete masonry units
2. Joint reinforcement.
3. Reinforcing bars
4. Mortar and grout

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data.

B. Shop Drawings.

1. Masonry Units: Shapes, sizes, profiles, and coursing.
2. Reinforcing Steel: ACI 315, show placement of bars in masonry, including elevations of walls.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: Data substantiation compliance with requirements for the following:

1. Structural Masonry: Net-area compressive strength.
2. Mortar and Grout: Mix designs for compressive strength.

B. Installer Qualification Statements: Evidence of passing International Masonry Institute upgrade training.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Grout and Reinforcing Installers: Workers who have completed International Masonry Institute grouting and reinforced masonry upgrade course.

B. Preconstruction Testing: Test each product. Complete testing 30 days, minimum, before scheduled field installation.

1. CMU: Compressive strength, per ASTM C140.
2. Mortar (Property Specification): Compressive strength, per ASTM C109/C109M.
3. Grout: Compressive strength, per ASTM C1019.

C. Mockup: Construct full thickness masonry wall containing all components required for finished construction.

1. Mockup Size: 60 inches long by 60 inches high.
2. Demonstrate the following:

a. Supporting structure.
b. EIFS System - See Section 07 24 00.
c. Tooled mortar joints.
d. Flashing.

3. Approved mockup establishes work results standard.
4. Remove mock up when Architect directs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Masonry Units: Store elevated above grade, protected from precipitation and stormwater runoff. Do not use wet units.
2. Mortar and Grout: Store elevated above grade, protected from moisture. Do not use materials that have become damp.

1.7 FIELD CONDITIONS

A. Cold Weather: Comply with TMS 602 requirements.

1. Do not use frozen or frost-damaged materials.

B. Hot Weather: Comply with TMS 602 requirements.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. CMUs: ASTM C90.

1. Net Area CMU Compressive Strength: 2000 psi, minimum.
2. Density Classification: Normal weight.
3. Nominal Size: 8 inches high by 16 inches long; 12 inches wide.

2.2 MORTAR AND GROUT

A. Portland Cement: ASTM C150/C150M, Type I.

1. Cold Weather Applications: Type III.
2. Color: White.

B. Hydrated Lime: ASTM C207, Type S.

C. Grout Aggregate: ASTM C404, coarse.

D. Water: Potable, free of substances that cause discoloration or adversely affect mortar setting or strength.

E. Mortar Mixes:

1. Mortar: Portland cement-lime mortar, ASTM C270, Proportion Specification.
2. Mortar Compressive Strength:

    a. Structural Masonry: Mortar type required to provide masonry compressive strength shown on Drawings.

3. Admixtures: Containing no calcium chloride.

F. Grout Mixes:

1. Masonry Grout: ASTM C476, complying with Table 1.15.1 in TMS 602 for dimensions of grout spaces and pour height.
2. Grout Compressive Strength: Match F'm compressive strength of wall.
3. Slump: 8 to 11 inches per ASTM C143/C143M.

2.3 STEEL MATERIALS

A. Stainless Steel Wire: ASTM A580/A580M, Type 316.

B. Stainless Steel Sheet: ASTM A666, Type 316.

C. Stainless Steel Anchors: ASTM F593 and ASTM F594, Alloy Group 2.

2.4 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi, deformed billet bars, uncoated finish.

1. Rebar Positioners: Preformed stainless steel wire positioned in mortar beds to support reinforcing steel.

a. Manufacturers and Products:

1) Heckmann Building Products 376.
2) Hohman & Barnard RB Series.
3) Wire-Bond O-Ring Series.

2.5 JOINT REINFORCEMENT

A. Joint Reinforcement: ASTM A951/A951M.

1. Exterior Walls: Stainless steel.
2. Side Rod Wires: 0.148 inch diameter.
3. Cross Rod Wires: 0.148 inch diameter.
4. Length: 10 feet, minimum.
5. Corners: Prefabricated or field-fabricated.

B. Masonry Joint Reinforcement: Ladder type.

1. Manufacturers and Products:

a. Heckmann Building Products #1100.
b. Hohmann & Barnard 220 Ladder Mesh.
c. Wire-Bond Ladder 2 Wire.

2.6 SHEET METAL FLASHING

A. Stainless Steel Flashing:

1. Stainless Steel Sheet: ASTM A240, Type 304, 0.016 inch thick.
2. Solder: ASTM B32, Grade Sn60, type recommended by flashing manufacturer.

B. Flashing Fabrication: Cut and form flashing as follows:

1. End Dams: Extend flashing 6 inches minimum beyond lintels and turn up 2 inches minimum.
2. Drip Edges: Extend flashing through veneer, turn down 45 degrees and hem edge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive Work.

1. Verify foundations are within specified tolerances.
2. Verify reinforcing is properly placed.
3. Verify rough-in for piping and electrical systems are properly placed.

3.2 PREPARATION

A. Coordinate placement of anchors provided under other Sections.

3.3 INSTALLATION - GENERAL

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Use full size units unless cutting is unavoidable. Cut units to provide clean, sharp, unchipped edges. Conceal cut edges wherever possible.

C. Protection During Installation: Cover open masonry walls, projections, and sills when work is not in progress, utilize waterproof membrane.

1. Extend protection 24 inches, minimum, on both sides of wall.

D. Stain Prevention: Immediately remove mortar and soil.

1. Protect in place construction below work from mortar droppings.
2. Protect walls from rain water splashing up from ground or scaffold.

3.4 CONCRETE MASONRY UNITS

A. Coursing:

1. Bond: Running.
2. Mortar Joints: Concave.

B. Joint Reinforcement Placement:

1. 16 inch intervals.
2. First and second course below top of walls.
3. Above and Below Openings: Installed in first and second courses, 16 inches minimum each side of opening.
4. Corners and Intersections: Reinforced with prefabricated units or field-formed units.

C. Reinforcement and Grouting: Follow TMS 602.

1. Grouted Components: See Drawings.

    a. Support and secure reinforcing bars from displacement.
    b. Place and consolidate grout fill without displacing reinforcing.
    c. At bearing locations, fill masonry cores with grout for minimum 12 inches both sides of opening.

2. Grout Pour Height: 60 inches, maximum.

3.5 FLASHING, WEEPS, AND DRAINAGE

A. Flashing: Install flashing where shown on Drawings and at obstructions to downward flow of water in wall.

B. Rigid Sheet Metal Flashing:

1. Extend flashing horizontally through EIFS, extend out beyond face and turn down and hem to form continuous drip edge.
2. Turn flashing up backup construction, 8 inches minimum and secure in termination bar.

3.6 LINTELS

A. Install lintels over openings.

3.7 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Retesting of Failed Tests: Performed at Contractor's expense.
2. Do not begin construction until inspectors have verified compliance of materials.
3. Do not use materials that fail tests and inspections.

B. CMU Compressive Strength Test: ASTM C140.

C. Mortar Tests: Test each mix provided per ASTM C780 to determine the following:

1. Mortar Aggregate Ratio.
2. Air Content.
3. Consistency.
4. Board life.

D. Grout Compressive Strength Test: ASTM C1019.

3.8 REPAIRING AND POINTING

A. Repairing and Replacing:

1. Remove and replace chipped, broken, or stained units.
2. Remove and replace units that do not match adjacent units.
3. Set replacement units in fresh mortar; point to eliminate evidence of replacement.

B. Pointing: Enlarge voids and holes and fill with mortar. Point joints to provide neat, uniform appearance.

3.9 CLEANING

A. In Progress Cleaning: Dry brush to remove excess mortar before tooling joints.

B. Final Cleaning: Clean exposed masonry as follows:

1. Allow mortar to set and cure.
2. Scrape to remove excess mortar.
3. Clean decorative concrete masonry by bucket-and-brush hand-cleaning method per BIA Technical Note 20.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Miscellaneous metal supports and lintels
2. Roof access ladders
3. Bollards.

B. Principal Products

1. Aluminum crossover ladders
2. Miscellaneous steel supports and framing.
3. Stair nosings
4. Concrete-clad steel bollards.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metal nosings for stairs.
2. Manufactured ladders and bollard covers.

B. Shop Drawings: Layouts, details, connections, anchorages.

1. Ladders.
2. Bollards.

C. Samples:

1. Stair Nosings: 6 inch long section.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Provide copies of welder certificates as informational submittals if requested by Architect.

1. Steel Fabrications: AWS D1.1, Structural Welding Code - Steel.
2. Aluminum Fabrications: AWS D1.2, Structural Welding Code - Aluminum.

1.4 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Structural Wide Flange Shapes: ASTM A992.

B. Steel Hollow Structural Sections: ASTM A500, Grade B.

C. Other Steel Structural Shapes: ASTM A36.

D. Steel Plates: ASTM A36 or A572, Grade 50.

E. Steel Pipe: ASTM A53, Grade B.

F. Steel Sheet: ASTM A653, Grade 33 Structural Quality, G40 galvanizing.

G. Steel Bolts: ASTM A307, Grade A or B, heavy hex style.

1. Finish: Hot dip galvanized.

H. Steel Nuts: ASTM A563, types appropriate for bolts

1. Finish: Hot dip galvanized.

I. Welding Materials: AWS D1.1, types as required for materials being welded.

2.2 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T5.

B. Aluminum Sheet: ASTM B209, Alloy 6063, Temper T6.

C. Aluminum Drawn Seamless Tubes: ASTM B210, Alloy 6063, Temper T6.

D. Aluminum Bars: ASTM B211, Alloy 6063, Temper T6.

E. Bolts, Nuts, and Washers for Aluminum Components: Stainless steel, Type 316.

F. Welding Materials: AWS D1.2, types as required for materials being welded.

2.3 MISCELLANEOUS MATERIALS

A. Post-Installed Anchors: Torque controlled expansion or chemical anchors.

1. Material: Stainless steel.

B. Anchors for Embedment in Concrete: Wedge type for adjustable bolt location; malleable iron or cast steel. Supply bolts, washers, and shims with ASTM F2329 hot-dip galvanized finish.

C. Shop Primer: primer specified in Section 09 90 00.

D. Zinc Rich Primer: SSPC Paint 20, Type II Organic.

E. Separation Coating: Bituminous paint; SSPC-Paint 12.

F. Stair Nosings: Extruded aluminum with slip-resistant epoxy-quartz abrasive inserts.

1. Manufacturers:

a. Balco.
b. Wooster Products, Inc.
c. Nystrom.

2. Length: Tread width minus 4 inches.
3. Configuration: Single component, cast-in fasteners.
4. Aluminum Finish: Mill.
5. Insert Color: Architect selected.

2.4 FABRICATION - GENERAL

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to uniform small radius.

E. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish 3.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Tolerances:

1. Squareness: 1/8 inch maximum difference in diagonal measurements.
2. Face Offset: 1/16 inch, maximum.
3. Misalignment of Adjacent Members: 1/16 inch, maximum.
4. Bow: 1/8 inch in 48 inches, maximum.
5. Plane: 1/8 inch deviation in 48 inches, maximum.

2.5 FABRICATION - LINTELS

A. Loose Steel Lintels: Steel sections, size and configuration shown on Drawings, length for minimum 8-inch bearing on both sides of opening.

B. Finishes:

1. Exterior Walls: Galvanized and shop primed.
2. Interior Walls: Shop primer.

2.6 FABRICATION - OVERHEAD DOOR FRAMES

A. Frames: Steel channels with minimum 4 adjustable jamb anchors.

1. Finish: Galvanized and shop primed.

2.7 FABRICATION - BOLLARDS

A. Bollards: Schedule 40 steel pipe.

1. Diameter: 6 inches.
2. Fill metal-capped bollards with concrete. Cure concrete minimum 7 days before installation.
3. Anchorage: Sleeves embedded in concrete or cored holes.
4. Finish: Galvanized.

B. Concrete Fill: 3,000 psi concrete.

C. Precast Concrete Bollard Covers: Fabricated with sleeves for installation over steel pipe bollards.

1. Size: 12 by 12 inches square, 36 inches tall, flat top.
2. Reveal: 1 by 1 inch all four sides, 4 inches from top of bollard
3. Color and Finish: See Drawings.

2.8 FABRICATION - LADDERS

A. Manufactured Parapet Crossover Ladders with Platform and Return: OSHA 1926.1053; Aluminum.

1. Manufacturers:

a. Alaco Ladder Company 565-PRPC
b. O'Keefe's, Inc. Model 503
c. Royalite ELL Series.

2. Side Rails: Aluminum channels with cover plates.
3. Rungs: 1-1/4 inch square serrated extruded aluminum spaced 12 inches on center.
4. Platform: Serrated treads.

5. Aluminum Finish: Mill or clear anodized.

2.9 STEEL FINISHES

A. Prepare surfaces to be primed per SSPC SP 2.

B. Clean surfaces of rust, scale, grease, and foreign matter before finishing.

C. Do not prime surfaces in direct contact with concrete or where field welding is required.

D. Galvanizing: ASTM A123; hot dip galvanize after fabrication.

E. Prime paint items in fabrication shop with one coat

F. Galvanizing for Fasteners, Connectors, and Anchors:

1. Hot-Dipped Galvanizing: ASTM A153.

2.10 ALUMINUM FINISHES

A. Aluminum: Mill finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate installers.

C. Apply separation coating to aluminum surfaces contacting dissimilar metals, concrete, and masonry.

3.2 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Separate dissimilar exterior metals with non-absorptive gaskets.

C. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

D. Fasten work rigidly and securely to supports.

E. Field weld components per AWS D1.1.

F. Obtain Architect approval before site cutting or making adjustments not scheduled.

G. After erection, touch up welds, abrasions, and damaged finishes with prime paint or zinc-rich paint to match shop finishes.

H. Miscellaneous Framing and Supports:

1. Attach supports rigidly and securely to building structural elements.
2. Brace overhead support framing to prevent movement of supported items.

I. Bollards:

1. Anchor bollards in sleeves or cored holes with anchorage cement or non-shrink grout. Slope cement or grout 1/4 inch.
2. Fill bollards with concrete.

3.3 INSTALLATION TOLERANCES

A. Plumb: Maximum 1/4 inch deviation per story or for every 12 ft in height, whichever is greater; non-cumulative.

B. Alignment: Maximum 1/8 inch offset.

C. Position: Maximum 1/4 inch deviation.

3.4 ADJUSTING

A. Clean and touch up damaged primer paint with same product applied in shop.

END OF SECTION

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Handrails and guardrails for interior and exterior concrete stairs

B. Principal Products

1. Manufactured aluminum railings

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate railing post installation with cast-in-place concrete stairs.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Concrete installer.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Railing system componenets.
2. Handrail brackets.
3. Shop primer.
4. Prefinished Components: Initial selection color .

B. Shop Drawings:

1. Railing layout, profiles and sizes, and anchorage details.
2. Railing connections.
3. Anchorage accessories and fasteners.

1.4 INFORMATIONAL SUBMITTALS

A. Delegated Design Submittals: Sealed calculations and shop drawings.

1. Guards and infill.

2. Handrails.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of railings.

B. Licensed Professional Qualifications: Engineer experienced in designing railings, licensed in New Jersey.

1.6 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabricating. Show field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 ALUMINUM RAILINGS

A. Manufactured Aluminum Railings:

1. Manufacturers and Products:

a. Hollaender Interna-Rail.
b. Julius Blum & Co. Inc. Connectorail.
c. Wagner Companies Wagnerail.

B. Components:

1. Rails and Posts: 1-1/4 inch diameter.
2. Guard Infill: Round tubes.
3. Joints and Connections: Extruded aluminum.

a. Nonwelded: Connect members with concealed fittings and fasteners.

4. Exposed Fasteners: Stainless steel, flush countersunk screws or bolts; consistent with railing design.
5. Anchors: Stainless steel; selected to meet structural performance requirements and substrate conditions.

C. Wall Brackets:

1. Wall Mounted Brackets: Concealed fastener design.

a. Material and Finish: Same as railing.
b. Clearance: 1-1/2 inch clear from handrail to wall surface.

D. Aluminum Finish: Mill.

2.2 PERFORMANCE

A. Delegate railing design to manufacturer licensed Professional Engineer.

B. Handrail Structural Design:

1. Live Loads: 100 psf uniform, 300 lbf concentrated, non-simultaneous.

C. Guard Structural Design:

1. Top of Guard: 50 psf, uniform and 200 lbf concentrated, both omnidirectional and non-simultaneous.
2. Guard Infill: 50 psf uniform and 200 lbf concentrated, both horizontal and non-simultaneous.

D. Allowable Deflection: 1/360, maximum.

2.3 INSTALLATION MATERIALS

A. Bituminous Paint: ASTM D1187 asphalt emulsion.

B. Grout: ASTM C1107, factory-packaged nonmetallic, shrinkage-resistant grout for exterior use.

C. Embedded Sleeves: Stainless steel tubes; sized to fit posts, 6 inches long, minimum, with closed bottom.

2.4 FABRICATION

A. Factory Assembly: Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as railing assembly.

E. Accurately form components to suit stairs and landings, to each other and to building structure.

F. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

G. Railing Ends: Closed.

H. Changes in Direction:

1. Uniform, without out buckling, twisting, deforming or cracking surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive work.

B. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Anchor Posts to structure.

1. Posts: Preset sleeves in concrete; set post in sleeve and fill space around post with grout.

C. Attach Railings:

1. Wall Mounting: Mount with wall brackets.
2. Guardrail Mounting: Fasten railing brackets to posts.

D. Assemble with spigots and sleeves to accommodate tight joints and secure installation

E. Exterior Railings: Locate weep holes to promote water drainage.

3.4 CLEANING

A. Clean aluminum with soap and clean water.

3.5 PROTECTION

A. Protect railings during construction period against soiling and damage.

END OF SECTION

SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Rough carpentry associated with roofing and copings

B. Principal Products

1. Wood nailers and blocking

1.2 ACTION SUBMITTALS

A. Product Data:

1. Wood preservative treatment.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store lumber indoors, protected from elements.
2. Store lumber elevated above grade, protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: DOC PS 20. Grading rules certified by ALSC Board of Review.

1. Maximum Moisture Content: 19 percent.

B. Wood Preservative (Pressure Treatment): AWPA U1 Category UC3b.

1. ACQ Preservative: Water-borne ammoniacal copper quat (ACQ) preservative.
2. Applications:

a. Roofing and Exterior Wall Assemblies: Wood nailers and blocking; Category UC2.
b. Concrete- and Masonry-Adjacent: Wood plates, sills, and blocking; Category UC3b.

c. Items shown on Drawings.

3. Kiln-dry after treatment.

a. Lumber: 19 percent maximum moisture content.
b. Plywood: 15 percent maximum moisture content.

2.2 INSTALLATION ACCESSORIES

A. Fasteners and Anchors:

1. General: Comply with requirements for wood member size and type.

a. ACQ Preservative Treated Wood: Type 316 stainless steel.
b. Other Applications: ASTM A153/A153M hot-dip galvanized.

2. Power-Driven Fasteners: NES NER-272.
3. Wood Screws: ASME B18.6.1.
4. Screws for Fastening to Metal Framing:

a. Cold-Formed Metal Framing: ASTM C954.
b. Other Metal Framing: ASTM C1002.

5. Anchors:

a. Toggle bolt type for anchorage to hollow masonry.
b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
c. Bolt or ballistic fastener for anchorages to steel.

B. Separation Layer: Butyl Rubber or rubberized asphalt flashing sheet membrane.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set members level and plumb, in correct position.

B. Place horizontal members crown side up.

C. Install continuous flexible flashing separator as follows:

1. ACQ Wood-Preservative-Treated Lumber: Between wood and metal decking.

END OF SECTION

SECTION 07 13 26
SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Waterproofing below grade foundation walls

B. Principal Products

1. Modified bituminous self-adhering sheet waterproofing
2. Protection board
3. Rigid insulation

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate Work results of this Section with foundation insulation installation..

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting concrete work to receive waterproofing.
2. Additional Attendees:

   a. Waterproofing membrane manufacturer.
   b. Concrete contractor.
   c. Installers of elements penetrating waterproofing.

3. Additional Agenda Items:

   a. Substrate preparation.
   b. Testing and inspection.
   c. Protecting and repairing waterproofing.

1.3 ACTION SUBMITTALS

A. Product Data: Waterproofing membrane and accessory products.

B. Shop Drawings:

1. Indicate joint and termination conditions, details at penetrations, and conditions of interface with other materials.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

1. Groundwater composition is not deleterious to waterproofing membrane.

B. Manufacturer Reports: Field inspection reports.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer warranty documentation.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Trained or approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet waterproofing and accessories in manufacturer's undamaged packaging.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Perform work within following limitations.

1. Temperature: Do not apply membrane when air or surface temperatures are below 40 degrees F.
2. Precipitation: None occurring during installation of the Work or forecast within 24 hours.
3. Protect rolls from direct sunlight until ready for use.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. General: Provide waterproofing components manufactured or recommended by primary membrane manufacturer for a fully compatible system.

B. Modified Bituminous Sheet Waterproofing: Self adhering sheet, rubberized asphalt laminated to polyethylene or aluminum film reinforcement, with release liner.

1. Manufacturers and Products:

a. American Hydrotech, Inc. VM 60.
b. AVM Aussie Mate 580-AL
c. Carlisle Coatings & Waterproofing Inc. CCW MiraDRI 860/861.

d. CETCO Envirosheet.
e. GCP Applied Technologies, Inc. Bituthene 3000/Low Temperature.
f. Henry Company Blueskin WP 200.
g. W.R. Meadows Mel-Rol Low-Temp.
h. Polyguard Products, Inc. Polyguard 650.

C. Installation Materials:

1. Transition Strips: Self-adhering, rubberized-asphalt sheet waterproofing strips.
2. Liquid Accessory Materials:

a. Primer: Waterproofing manufacturer's recommended liquid primer.
b. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
c. Liquid Membrane: Elastomeric, cold fluid applied liquid; trowel grade or low viscosity.
d. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

3. Mastic, Adhesives, and Tapes: Manufacturer's recommended products.
4. Termination Bars: Stainless steel, approximately 1 by 1/8 inch thick, predrilled at 9-inches on center.

2.2 PROTECTION COURSE

A. Protection Course: ASTM D6506, semirigid sheets, fiberglass or reinforced asphaltic core laminated to asphalt saturated fibrous liners on both sides.

1. Nominal Thickness: 1/8 inch.
2. Adhesive: Rubber/solvent based, recommended by membrane manufacturer.

2.3 MOLDED SHEET DRAINAGE PANELS

A. Molded-Sheet Drainage Panel, Nonwoven Geotextile Type: Composite drainage panel with nonbiodegradable molded-plastic sheet drainage core, and nonwoven, needle-punched geotextile facing laminated to one side of core and a polymeric film laminated to the other side.

1. Manufacturers and Products:

a. American Hydrotech, Inc. Hydrodrain 400.
b. AVM Drain Board 2000.
c. Carlisle Coatings & Waterproofing Inc. CCW MiraDRAIN 6000.
d. GCP Applied Technologies Inc. Hydroduct 220.
e. Polyguard Products Polyflow 10.
f. W.R. Meadows Mel-Drain 5035.

2. Flow Rate: Vertical flow 9 to 15 gpm per ft.
3. Openings: No. 70 sieve maximum.

2.4 INSULATION

A. Board Insulation: Extruded-polystyrene, ASTM C578, shiplap edged, Type IV.

1. Manufacturers and Products:

a. DiversiFoam Products CertiFoam 25.
b. DuPont STYROFOAM.
c. GreenGuard Type IV 25 psi XPS Insulation Board.
d. Owens Corning FOAMULAR 250.

B. Insulation Fasteners:

1. Zinc-coated metal power-actuated fasteners with integrated plastic washer caps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify substrate surfaces are free of matter detrimental to adhesion or application of waterproofing system.
2. Verify items penetrating substrate surfaces to receive waterproofing are securely installed.
3. Verify substrate surface slopes to drain for horizontal waterproofing applications.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Do not apply waterproofing to surfaces unacceptable to manufacturer.

C. Seal cracks and joints with sealant materials as recommended by waterproofing manufacturer.

D. Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

3.3 MEMBRANE INSTALLATION

A. Roll out membrane. Minimize wrinkles and bubbles.

B. Remove release paper layer. Roll out on substrate with a mechanical roller for full contact bond.

C. For vertical application, mechanically-fasten top-leading edge approximately 1/2 inch from edge of sheets with fasteners approved by the manufacturer.

D. Lap sides and ends of waterproofing sheets.

E. Reinforce membrane with multiple thickness of membrane material over joints.

F. Lap joints on sloped surfaces in direction of drainage with higher sheets lapping lower sheets.

G. Install and seal all flexible flashings.

H. Seal membrane and flashings to adjacent materials.

I. Seal and counterflash all penetrations, including all fastener penetrations.

3.4 DRAINAGE AND PROTECTION BOARD INSTALLATION

A. Place board with correct side outward, directly against membrane, butt joints, place to encourage drainage downward.

B. Adhere board to substrate with mastic. Scribe and cut boards around projections, penetrations, and interruptions.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Representative:Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.

B. Provide test and inspection reports.

3.6 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing, board insulation, and drainage panels from damage, wear, and the elements during remainder of construction period.

C. Correct or replace damaged or deficient waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION

SECTION 07 24 00
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Water drainage type exterior insulation and finish systems.

B. Principal Products

1. Exterior insulation and finish system.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate EIFS installation with installation of sheathing and adjacent doors, storefront, and masonry.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Submit system materials.

1. Primary Components:

a. Finish coats.
b. Reinforcing.
c. Insulation.
d. Air barrier.
e. Adhesive.

2. Associated Products:

a. Joint sealants.
b. Flashing.

B. Shop Drawings:

1. Assembly details.
2. Wall joint patterns.

3. Profiles of moldings and sills made from insulation.
4. Transitions to other elements.

C. Samples:

1. Assembly Samples: Assemble EIFS on plywood, 12 by 12 inches in size, showing air barrier layer, adhesive, insulation, reinforcement, and finish system.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Manufacturer Certificates: Certify the following.

a. Substrates are acceptable to EIFS manufacturer.
b. EIFS complies with requirements.
c. Accessory materials installed with EIFS are acceptable to EIFS manufacturer.

B. Test and Evaluation Reports: Independent testing agency test results showing:

1. Air barrier complies with requirements

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Certified in writing by EIFS manufacturer as qualified to install system.

B. Mockups: Construct EIFS wall mockup on masonry mockup specified in Section 04 20 00. Include air barrier and all system layers. inches minimum size. Demonstrate product interfaces, intersections, and terminations.

1. Use "stepped back" assembly to demonstrate application of each material layer.
2. Approved mockups establish work results standard.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.

1.7 FIELD CONDITIONS

A. Prepare EIFS materials under conditions within manufacturer recommended limitations.

B. Protect installed EIFS from inclement weather until material has dried.

C. Limit insulation board exposure to sunlight to duration recommended by manufacturer. Apply base coat as rapidly as possible.

1.8 WARRANTY

A. Manufacturer Warranty:

1. EIFS: Warrant against product and installation failure.
2. Failure includes:

a. Bond integrity.
b. Weathertightness.
c. Deterioration beyond normal weathering.

3. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

A. EIFS: Drainage type, reinforced finish coating on insulation board adhesively applied to air- and water-resistive barrier over substrate. System acts as continuous air- and water-resistive assembly.

1. Manufacturers and Products:

a. Dryvit Outsulation Plus MD.
b. Master Builders Solutions Senergy Senerflex Channeled Adhesive CI.
c. Parex USA Standard WaterMaster CI.
d. Sto StoTherm ci

2. Finish Coat: Water-based, air curing acrylic or polymer based finish with integral color and texture.
3. Base Coat: Fiber-reinforced acrylic or polymer-based product.
4. Reinforcing Mesh: EIFS manufacturer open-weave, glass fiber fabric.

a. Mesh Weight and Tensile Strength: Recommended by EIFS manufacturer for impact classification.

5. Insulation Board:

a. Molded expanded polystyrene board, ASTM C578, Type II.
b. Thickness: See Drawings.

6. Air- and Water-Resistive Barrier Coating: Fluid-applied membrane, furnished or approved by EIFS manufacturer.
7. Fluid-Applied Flashing: Flexible water based polymer material suitable for use with reinforcing mesh.
8. Color and Texture: Match Architect sample.

B. Accessory Materials:

1. Insulation Adhesive: EIFS manufacturer recommended type.
2. Trim: EIFS manufacturer standard PVC trim accessories, as required for a complete project and including starter track and drainage accessories.
3. Joint Sealants: EIFS manufacture recommended type.

2.2 PERFORMANCE

A. EIFS Performance: ASTM E2568 and ICC-ES AC219 and the following:

1. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes per ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray.
2. Air Infiltration:

    a. Material: 0.004 cfm/sf at a pressure differential of 1.57 lb/sq ft per ASTM E283 or ASTM E783.
    b. Assembly: 0.04 cfm/sf at 1.57 lb/sq ft per ASTM E2357.

3. Drainage: Average minimum efficiency of 90 percent; test per ASTM E2273 for 75 minutes
4. Durability: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when tested per the following:

    a. Salt Spray Resistance: 300 hours exposure per ASTM B117.
    b. Freeze-Thaw Resistance: 10 cycles per ICC-ES AC219.
    c. Weathering: 2000 hours per ASTM G153 Cycle 1.
    d. Water Degradation: 14 days per ASTM D2247.

5. Mildew Resistance: No growth at 28 days per ASTM D3273.

B. Impact Classification: ASTM E2568, tested per ASTM E2486.

1. Ultra High Performance:

    a. Wall surfaces within occupant reach.
    b. Corners.

2. High Performance: Other surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify that substrates are sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation.
2. Verify substrate is acceptable to EIFS manufacturer.

B. Substrate Tolerances:

1. Deflection: 1/240 of span, maximum.
2. Flatness: 1/4 inch variation in 48 inch radius.

C. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

3.2 PREPARATION

A. Protect adjoining work and property during installation.

3.3 INSTALLATION - GENERAL

A. Install EIFS per ASTM C1397.

3.4 INSTALLATION - AIR- AND WATER-RESISTIVE BARRIER

A. Seal all substrate transitions and intersections with other materials to form continuous air- and water-resistive barrier on substrate.

B. At door and window rough openings and other wall penetrations, seal air- and water-resistive barrier and flexible flashings to rough opening before installing metal flashings, sills, or frames.

C. Lap flexible flashing or flashing tape 2 inches minimum on each side of joint or transition.

3.5 INSTALLATION - INSULATION

A. Adhesive Attachment: Use method required by manufacturer to achieve drainage efficiency specified; do not close up drainage channels when placing insulation board.

1. Supplemental Mechanical Attachment: Fasten insulation to substrate when recommended by manufacturer.

B. Place boards to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps over 1/16 inch.

1. Interrupt insulation for control and expansion joints where shown on Drawings.

C. Fill gaps greater than 1/16 inch with EPS or spray foam insulation.

D. Rasp irregularities off surface of installed insulation board.

E. Cut aesthetic reveals in insulation at locations and profiles shown on Drawings.

F. Build up layers of insulation and carve to form projections and reveals shown on Drawings.

G. Wrap reinforcing mesh over insulation at openings and terminations that are not to be protected with trim.

3.6 INSTALLATION - FINISH

A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at all terminations of the EIFS. Install reinforcing mesh in wet base coat.

1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
2. Allow base coat to dry a minimum of 24 hours before next coating application.

B. Double-Layer Reinforcing Mesh: Apply second base coat and second layer of reinforcing mesh where required for impact resistance. Lap layers 2-1/2 inches minimum.

C. Additional Reinforcing: Embed additional minimum 8-inch wide reinforcing strips in base coat at outside corners, openings, and projections.

D. Apply finish coat. Embed finish aggregate, and finish to match approved mockup.

E. Finish Coat Thickness: Manufacturer recommended.

F. Apply sealant at joints between EIFS and dissimilar materials.

3.7 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.

B. Tests and Inspections:

1. EIFS Assembly: Test per ASTM E2359 or ICC-ES AC219.

C. Non-Conforming Work: Remove and replace, and re-test.

D. Prepare test and inspection reports.

3.8 CLEANING

A. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.9 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION

SECTION 07 50 00
MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Fully adhered elastomeric membrane roofing system.

B. Principal Products

1. Roof membrane.
2. Cover board.
3. Insulation.
4. Substrate board.

1.2 REFERENCES

A. Definitions:

1. Roofing Terminology: See ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Agenda Items:

    a. Preparation procedures.
    b. Installation procedures.
    c. Coordination and scheduling required with related Work.
    d. Protection of construction and site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Roofing membrane and accessory products.
2. Substrate board.
3. Roof insulation and cover board.
4. Roof walkway material.

B. Shop Drawings: Include plans, elevations, sections, details, intersections with adjacent assemblies, terminations, and attachments, including:

1. Base flashings.
2. Membrane terminations.
3. Flat and tapered insulation, including cants and slopes.

C. Samples:

1. Membrane Sheet: 6 by 6 inch sample of each type and color.
2. Walkway materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. Installer: Manufacturer's authorization.

B. Certificates: Manufacturer affidavit that Project design and conditions have been reviewed and that the installation will be fully warrantable if correctly installed. This submittal may be in the form of a photocopy of manufacturer's authorization to Installer to proceed with installation.

C. Field Quality Control Submittals: Field test and inspection reports.

D. Manufacturer Reports: Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Roof system maintenance requirements.

B. Warranty Documentation: For complete roof system.

C. Project Plaque: Provide permanent sign or framed document with the following information attached to wall near primary access to main roof.

1. Roofing installer name, address, and telephone number.
2. Roofing system manufacturer name, address, and telephone number.
3. Starting date of warranty and length of warranty period.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Licensed, authorized, or approved by roofing manufacturer to install manufacturer’s roofing system and provide full specified warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements: Store roofing system components protected from the elements, precipitation and standing water, freeze/thaw cycling, and protected from sunlight, if required.

1.9 FIELD CONDITIONS

A. Ambient Conditions: Perform work within limitations recommended by manufacturer.

1.10 WARRANTY

A. Manufacturer Warranty: Warrant roofing system against failure.

1. Total System Warranty: Include primary roof membrane and substrate boards, roof insulation, cover boards, flashings, and metal edge assemblies, and other components of roofing system.

a. Warranty Period: 20 years.
b. Dollar Limit: None.

PART 2 - PRODUCTS

2.1 EPDM ROOFING

A. EPDM Sheet: ASTM D4637, Type II, scrim or fabric internally reinforced.

1. Manufacturers:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products.
c. GenFlex.
d. Johns Manville.
e. Versico Incorporated

2. Membrane Thickness: 60 mils.
3. Exposed Face Color: White on black.

2.2 COMPONENT MATERIALS

A. General: Provide components of roofing system recommended by manufacturer for a complete system.

1. Component materials are all compatible with each other and adjacent materials.

B. Adhesive: Manufacturer’s standard water based bonding adhesive.

C. Seams: Butyl splicing adhesive, single component, and cleaner or butyl splicing tape, minimum 3 inches wide with release film, and rubber polymer primer.

D. Flexible Flashing: Same material as roofing membrane, manufacturer's recommended thickness.

E. Lap Joint Sealant: Manufacturer’s standard, color to match membrane.

F. Butyl Mastic: Manufacturer’s standard water stop mastic.

G. Termination Bars: Manufacturer’s standard stainless steel, pre-drilled for included anchors.

H. Fasteners: Compliant with FM Global 4470 for corrosion resistance, including metal or plastic washers, and acceptable to roof system manufacturer.

I. Accessories: Miscellaneous flashing, sealant, reinforcing, sealants, and other accessories as recommended by manufacturer for a complete installation.

1. Colors: Match roofing membrane color.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177, gypsum core, glass-mat facing, water-resistant.

1. Manufacturers and Products:

a. Georgia-Pacific Corporation DensDeck.
b. National Gypsum Company Gold Bond eXP Extended Exposure Sheathing.
c. USG Corporation Securock Glass Mat Roof Board.

2. Thickness: 5/8 inch, Type X.

B. Fasteners: FM Global 4470 compliant for corrosion resistance, including metal or plastic washers.

2.4 ROOF INSULATION

A. General: Roof insulation, preformed boards, manufactured or approved by roof membrane manufacturer, manufacturer's standard sizes, thicknesses as indicated.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 3.

1. Manufacturers:

a. Atlas Roofing Corporation.
b. Carlisle SynTec Incorporated.
c. Firestone Building Products.
d. GAF Materials Corporation.
e. Hunter Panels.
f. Insulfoam LLC.
g. Johns Manville.

h. Rmax, Inc.

2. Thickness: 2 inches maximum per layer.

C. Tapered Insulation: Factory formed, tapered insulation boards, 1/4 inch per foot slope or as shown on Drawings.

D. Special Shapes: Provide preformed insulation shapes to form crickets, saddles, tapers, and other shapes to facilitate drainage.

E. Fasteners: FM Global 4470 compliant for corrosion resistance, including metal or plastic washers.

F. Adhesive: Recommended by insulation manufacturer for adhering insulation layers together.

1. Adhesive Types: Asphaltic, asbestos free, cold-applied, Single or multi-component urethane low-rise, apply in beads or full spread as recommended by manufacturer..

2.5 COVER BOARDS

A. Water Resistant Gypsum Board: ASTM C1177 or ASTM C1278, inch thick .

1. Manufacturers and Products:

a. Georgia-Pacific Corporation DensDeck Prime with Eonic Technology.
b. National Gypsum Company DEXcell FA Glass Mat Roof Board.
c. USG Corporation Securock Gypsum Fiber Roof Board.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, heavy-duty, solid-rubber walkway pads, approved or acceptable to roof membrane manufacturer.

1. Slip-resistant.
2. Texture; Manufacturer’s standard.
3. Configuration: Walkway pads or rolls.
4. Thickness: Approximately 3/16 inch thick.

2.7 PERFORMANCE

A. Accelerated Weathering: ASTM G152, ASTM G154 or ASTM G155; withstand 2,000 hours of testing.

B. Impact Resistance: ASTM D3746 or ASTM D4272.

C. Compatibility: Roof system materials are to be compatible within themselves and with all adjacent material as installed.

D. Roof System Design: Certified by testing to resist uplift pressures as shown on Structural Drawings.

E. Fire/Windstorm Classification: Class 1A-120.

F. Hail Resistance Rating: SH.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine and verify conditions for compliance with roof system manufacturer's recommendations:

1. Substrate.
2. Roof openings and penetrations.
3. Curbs, nailers, and cants.

3.2 PREPARATION

A. Clean and prepare substrate per manufacturer's written instructions.

B. Protect roof drainage and other equipment and surfaces from roofing materials.

3.3 ROOFING INSTALLATION - GENERAL

A. Complete terminations, flashings, roofing installation, and temporary measures by end of each workday and during rain events.

3.4 INSTALLATION - SUBSTRATE BOARD

A. Install substrate boards with long sides perpendicular to roof slopes in straight lines, stagger end joints. Install with tight butt joints.

1. Fasten substrate board to steel deck flanges per FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

3.5 INSTALLATION - INSULATION

A. Do not allow insulation to be exposed to precipitation or left exposed at the end of the workday.

B. Install tapered insulation under area of roofing to conform to slopes shown on Drawings.

C. Install insulation to required thickness. Where overall insulation thickness is 2.7 inches or greater, install in layers with staggered joints from joints of previous layer. Stagger joints a minimum of 6 inches in each direction.

D. Install insulation with long sides in straight rows with end joints staggered between rows, butt joints at edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Fit insulation by trimming, within 1/4 inch of nailers, obstructions, and penetrations.
2. Trim and fit insulation at roof drains.

E. Mechanically Fastened and Adhered Insulation: Fasten first layer of insulation to deck using mechanical fasteners designed and sized for fastening roof insulation to each deck type.

1. Fasten first layer of insulation per FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Set each subsequent layer of insulation in ribbons or full spread adhesive, firmly pressing insulation in place.

3.6 INSTALLATION - COVER BOARD

A. Install cover boards over insulation with long sides in straight lines and end joints staggered between rows. Offset joints from insulation layer below a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Adhere cover boards per FM Global's "RoofNav" for specified Windstorm Resistance Classification.

3.7 INSTALLATION - ADHERED ROOFING MEMBRANE

A. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Align roofing to an accurate layout, maintaining side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing as recommended by manufacturer. Do not apply adhesive at splice areas of roofing.

E. Apply roofing with uphill side laps overlapping lower layers with slope of roof deck where possible.

F. Repair tears, voids, lapped seams, or defects in roofing that do not comply with requirements.

G. Spread sealant or mastic bed over deck-drain flanges at roof drains, and securely seal membrane roofing in place with clamping ring.

3.8 MEMBRANE SEAMING

A. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll laps of overlapping roofing per manufacturer's written instructions. Apply lap sealant and seal exposed edges of roofing terminations.

1. Apply continuous bead of in-seam sealant within splice if required by roofing system manufacturer.

3.9 INSTALLATION - BASE FLASHING

A. Adhere flashings and flashing accessories to substrates.

B. Apply adhesive to substrate and underside of sheet flashing, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners per roofing manufacturer's recommendations.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets per manufacturer's requirements. Seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate using termination bars.

3.10 INSTALLATION - WALKWAYS

A. Flexible Walkways: Adhere walkway components to substrate with compatible adhesive.

3.11 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.
2. Do not begin construction until inspectors have verified compliance of materials.
3. Do not use materials that fail tests and inspections.

B. Inspections:

1. Substrate conditions.
2. Substrate preparation.
3. Vapor barrier application, if required.
4. Membrane application.
5. Flashings.
6. Protection components.
7. Penetrations and drainage components
8. Furnish reports to Architect.

C. Electric Leak Detection: ASTM D7877 and ASTM D8231. Engage testing agency to survey entire roof area for potential leaksusing one of the following methods:

1. EFVM.
2. High-voltage spark testing.

3. Electric roller scanning platform.

D. Final Roof Inspection: Arrange for roofing system manufacturer or testing agency to inspect completed roofing installation.

E. Repair or remove and replace roofing system components that fail tests or do not comply with requirements.

3.12 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period.

B. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Wall and roof flashing

B. Principal Products

1. Prefinished aluminum sheets
2. Stainless steel sheets

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate flashing installation with roofing and EIFS work.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Coil-coated sheet metal.

B. Shop Drawings.

1. Show fabrication and profiles for each item.
2. Indicate base metals, thicknesses, and finishes.
3. Include attachment and connection details.
4. Include details for corners, changes in plane, expansion joints, and terminations.
5. Show locations of expansion joints.

C. Samples:

1. Coil-Coated Metal: 12-inch long sections in required finish.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation: Coil-coated sheet metal finish.

1.5 WARRANTY

A. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Environmental Performance:

1. Expansion and Contraction: Withstand thermal cycling over 120 degrees F ambient and 180 degrees F on material surfaces.

2.2 MATERIALS

A. Aluminum Sheet: ASTM B209, alloy and temper required for use and finish.

1. Finish: Two coat fluoropolymer.
2. Coil Coating Color: Architect selected.

B. Stainless Steel Sheet: ASTM A240; Type 316, dead soft fully annealed.

1. Surface: Smooth.
2. Finish: #4.

2.3 ACCESSORIES

A. Fasteners for Aluminum: Stainless steel, Type 316, with soft neoprene washers where exposed.

B. Fasteners for Other Metals: Same material and finish as item being fastened, with soft neoprene washers where exposed.

C. Solder: ASTM B32; type suitable for application and material being soldered.

D. Concealed Sealant: Butyl, ASTM C1311.

1. Manufacturers and Products:

a. Pecora Corporation BA-98.
b. Tremco Butyl Sealant.

E. Exposed Sealant: See Section 07 92 00 - Joint Sealants.

F. Separation Coating: Bituminous paint; SSPC-Paint 12.

G. Plastic Cement: ASTM D4586, Type I.

H. Surface-Applied Reglets: Extruded aluminum with bottom edge drip and top edge sealant recess. Supply with stainless steel screws with neoprene washers and anchorage devices appropriate to substrate.

2.4 FABRICATION

A. Fabrication Reference Standards:

1. SMACNA Architectural Sheet Metal Manual.

B. Form section shapes shown on Drawings, accurate in size, square, and free from distortion or defects.

C. Fabricate cleats of same material as sheet metal, interlocking with sheet.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Moving Joints: Sealed lapped, bayonet-type, or interlocking hooked seams.

F. Non-Moving Joints: Sealed watertight.

G. Roof Drain Flashing:

1. Material:

a. Stainless Steel: SMACNA recommended minimum thickness.

2.5 ALUMINUM FINISHES

A. Color Coating: Two-coat fluropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that roof openings are solidly set, reglets in place, and nailing strips located.

B. Verify that roofing base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Paint concealed uncoated metal surfaces with 15 mil minimum thickness separation coating.

3.3 INSTALLATION

A. Installation Reference Standards:

1. SMACNA Architectural Sheet Metal Manual.

B. Install flashing with concealed fasteners.

C. Secure fabrications with concealed fasteners where possible.

D. Apply plastic cement between metal and bituminous materials.

E. Separate dissimilar metals with separation coating or non-absorptive gaskets.

F. Counterflashing: Install counterflashing in contact with base flashing.

1. Anchor counterflashing in reglets with wedges and apply sealant to joint per Section 07 92 00 - Joint Sealants.
2. Drill counterflashing installed with surface-mounted reglets so that anchorage fasteners go through the sheet metal. Apply sealant to back side of top edge and fasten reglet to wall construction. Apply sealant to top edge per Section 07 92 00 - Joint Sealants.
3. Lap ends of counterflashing minimum 4 inches.

3.4 CLEANING

A. Remove soiling, stains, and hand prints.

END OF SECTION

SECTION 07 71 00
ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Coping caps designed to wtihstand roof uplift

B. Principal Products

1. Prefinished metal copings

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate work results of this Section with roofing and EIFS work for continuity of protection against water and air infiltration.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting in conjunction with roofing preinstallation meeting.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufactured coping system; include information on factory-fabricated termination and transition shapes.

B. Shop Drawings: Show profiles, joining method, location of accessory items, anchorage and flashing details, adjacent construction interface, and dimensions.

C. Samples: Minimum 6- by 8-inch samples of cover metal with required finish.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer or Independent testing agency test results showing wind uplift resistance as tested per ANSI/SPRI/FM 4435 ES-1.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty documentation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer of roofing system specified in Section 07 50 00.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prevent deformation, abrasion, and other damage during handling and installation.

B. Remove strippable finish protection film when recommended by manufacturer.

1.8 WARRANTY

A. Include roof specialties in warranty for roofing system specified in Section 07 50 00.

B. Coil-Coated Sheet Metal Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.1 MANUFACTURED ROOF EDGE SYSTEMS

A. Roof Edge Requirements: Engineered systems tested per ANSI/SPRI/FM 4435 ES-1 for securement of roofing membrane.

B. Manufactured Coping System: Snap-on cover with concealed gasketed splice plates that accommodate thermal movement and drain water out of system.

1. Manufacturers:

a. ATAS International, Inc.
b. Carlisle - Drexel Metals.
c. Hickman Edge Systems LLC
d. Metal-Era, Inc.
e. Petersen Aluminum.

f. SAF Perimeter Systems.

2. Configuration: See Drawings.
3. Cover Material: Aluminum sheet, smooth finish.
4. Cover Thickness: Required for edge securement.
5. Cover Finish: PVDF coil coating.
6. Securement: Continuous cleats.
7. Anchorage Fasteners: Stainless steel screws.
8. Accessories: Factory-fabricated units for terminations and changes in direction or plane.

2.2 PERFORMANCE

A. Structural Loads: See Structural Drawings.

B. Environmental Performance:

1. Expansion and Contraction: Accommodate 180 degree F surface and 120 degree F ambient temperature differential without failure.

2.3 ALUMINUM FINISHES

A. Color Coating: Two-coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

1. Color: Match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that wood blocking for support and anchorage is positioned correctly, securely fastened, level, and in plane.

B. Verify that installation surfaces are clean, dry, and free of foreign matter.

C. Verify that EIFS system installation is complete.

D. Verify that roof membrane flashing extends over anchorage blocking and is securely fastened to the blocking.

3.2 INSTALLATION

A. Install roof specialties to provide weatherproof performance and prevent water intrusion into building enclosure elements or interior.

B. Copings:

1. Install copings in straight lines with accurately aligned profiles.
2. Install anchorage base and cleats with screws.
3. Install splice plates with continuous gaskets that prevent lateral movement of water to void below cover.
4. Install covers with full engagement of anchorage cleats and uniform joint width.

3.3 CLEANING

A. Remove soiling and stains from installed components.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Firestopping penetration and joints

B. Principal Products

1. Firestopping sealants, putties, foams, and other materials used in firestopping systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate joint construction and penetrations to accommodate firestopping

B. Scheduling: Notify Owner's testing agency seven days minimum before firestopping installation and provide access for inspection.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Product characteristics, performance and limitation criteria.
2. Submit descriptions of tested designs listed in submitted schedule.

B. Engineering Judgements: For conditions not covered by listed designs, provide judgements on systems or assemblies to meet fire protection requirements by a licensed professional engineer, for presentation to authority having jurisdiction.

C. Schedule: List opening locations and sizes, penetrating items, and assembly numbers.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Licensed Professionals: Registered in state in which Project is located.

B. Certifications: From Installer that firestopping is installed properly.

C. Field Samples: Construct example of exposed firestopping, minimum size of a standard installation. Demonstrate finish.

1. Approved samples establish work results standard.

1.5 FIELD CONDITIONS

A. Ambient Conditions: Perform work within field conditions recommended by manufacturer of firestopping.

PART 2 - PRODUCTS

2.1 PENETRATION AND JOINT FIRESTOPPING

A. General:

1. Materials manufactured and installed to resist the spread of fire, smoke, and gasses, that maintain the fire resistance ratings of the horizontal and vertical assemblies into which they are installed.
2. All firestopping materials and systems are to be compatible with each other and substrates where installed.

B. Fire-Rated Wall Penetrations: Firestopping rated per ASTM E814 or UL 1479, positive pressure differential tested at 0.01 inch wg.

1. F-Rating: Equal to or greater than assembly where installed.

C. Fire Rated Joint Assemblies: Firestopping rated per ASTM E1966 or UL 2079.

1. Fire Resistance Rating: Equal to or greater than assembly where installed.

D. Exposed Firestopping Materials: ASTM E84; Flame Spread 25, Smoke Developed 450, maximum.

1. Color: Red.

E. Accessory Materials: Materials and components specified by firestopping manufacturer and approved by qualified testing and inspection agency that are required for a complete installation and fire rating of each firestopping assembly or system.

1. Forming and backing materials:

a. Rock wool and mineral wool insulation.
b. Sealants.
c. Form boards.
d. Fillers and backers for sealants.
e. Temporary forms.

2. Primers.

3. Collars.
4. Sleeves.

2.2 PERFORMANCE

A. Provide firestopping systems that are tested by a qualified testing agency acceptable to authorities having jurisdiction.

B. Mark firestopping systems with classification markings by one of the following.

1. UL “Fire Resistance Directory.”
2. FM Global “Building Materials Approval Guide.”
3. Intertek Group “Directory of Building Products.”

2.3 MATERIALS AND COMPONENTS

A. Collars and Sleeves: Factory assembled collars and sleeves, consisting of a metal outer sleeve lined with intumescent material, and flanges and gaskets to mount the unit and seal the ends.

B. Sealants:

1. Latex: Single component, moisture resistant after curing.
2. Silicone: Single component, neutral curing, pourable for horizontal and nonsag for vertical or sloped applications.

C. Intumescent Sheets: Composite sheets of galvanized steel and intumescent material designed for various opening sizes.

D. Wrap Strips: Foil faced, intumescent, elastomeric sheets.

E. Pillows: Compressible, intumescent cases.

F. Putties: Non-hardening, water-resistant, dielectric materials containing no inorganic fibers, silicones, or solvents.

G. Mortars: Prepackaged dry mixes of hydraulic cement, binders, and lightweight aggregates, mixed with water at installation site.

H. Silicone Foam: Multicomponent, site-mixed elastomer that expands and cures in-place as a stable, flexible foam.

2.4 MIXING

A. Mix materials to produce product characteristics required by manufacturer and testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Comply with manufacturer's requirements for each type of firestopping installation.

3.2 PREPARATION

A. Surface Preparation:

1. Mask surfaces that will remain exposed after installation of firestopping.

3.3 INSTALLATION

A. Forming Materials: Install to retain and properly shape installed firestopping to achieve required fire rating.

1. Remove combustible or temporary forming materials after curing firestopping.

B. Install firestopping materials to achieve required fire ratings.

1. Apply materials to adhere to all contact surfaces.
2. Fill all voids around openings.
3. Finish firestopping that will be exposed after curing.

3.4 IDENTIFICATION

A. Permanently attach identification labels within 6 inches of edge of firestopping installations. Make labels visible toward the direction from which a person might approach to remove or alter the firestopping.

B. Provide labels that contain the following:

1. Required Text: "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contact information for installation Contractor.
3. Firestopping testing agency's design designation.
4. Date of installation.
5. Name of Manufacturer.
6. Name of Installer.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Retesting of Failed Tests: Performed at Contractor's expense.
2. Do not begin construction until inspectors have verified compliance of materials.
3. Do not use materials that fail tests and inspections.

B. Testing: ASTM E2174.

C. Repair or replace firestopping that is damaged or removed during inspection and testing.

D. Complete enclosure Work over firestopping only after inspection reports indicated all firestopping is compliant with requirements.

3.6 CLEANING AND PROTECTION

A. Remove excess materials by methods approved by firestopping manufacturer. Do not damage adjacent materials.

B. Protect firestopping installations from damage or deterioration during the Work. Repair or replace any firestopping that is damaged or removed, before Substantial Completion.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Sealing exterior joints around doors, windows, roof metal, and other conditions.
2. Interior calking and joint sealing

B. Principal Products

1. Joint sealants

1.2 ACTION SUBMITTALS

A. Submittal Procedures:

1. Provide submittals for all sealants, exterior and interior, in a single group, regardless of how many subcontractors will install sealants. Multiple submittals for sealants are not acceptable.

B. Product Data:

1. Each sealant type.

C. Samples:

1. Cured sealant custom color ribbons; 12 inches minimum length.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer or independent testing agency test results showing:

1. Compatibility between sealant and substrate.
2. Priming requirements for each substrate and sealant.
3. Staining potential.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation: Sealants.

1.5 QUALITY ASSURANCE

A. Preconstruction Testing: Complete testing minimum 30 days before scheduled field installation.

1. Adhesion: Test exterior wall sealants for adhesion to metal, masonry, concrete, and EIFS per ASTM C794 to determine need for primer and substrate preparation.
2. Staining: Test exterior wall sealants for staining of EIFS per ASTM C1248.

1.6 FIELD CONDITIONS

A. Ambient Conditions: Perform work within following limitations.

1. Temperature: Perform work within sealant manufacturer temperature limits, but not below 40 deg F.

1.7 WARRANTY

A. Manufacturer Warranty:

1. Exterior Sealants: Warrant against product failure.

a. Failure includes loss of elastomeric properties and required performance attributes, and discoloration of substrates.
b. Warranty Period - Urethanes: Five years.
c. Warranty Period - Silicones: 20 years.

PART 2 - PRODUCTS

2.1 SEALANTS - GENERAL

A. Source Control: Provide one proprietary product for each type of sealant required, regardless of what subcontractor installs the sealant.

1. Installers of joint sealants under subsequent work packages must use the same proprietary sealants used in the first work package that includes joint sealants.

B. Select proprietary sealants for compatibility with other construction products that the sealants will contact.

C. Multiple colors may be required for exposed sealants to coordinate with substrate colors.

2.2 EXTERIOR EXPOSED NONTRAFFIC SEALANTS

A. Medium Modulus Silicone Nonstaining Sealant: Single-component, nonsag, neutral-curing; ASTM C920, Type S, Grade NS, Class 50, Use NT; classed as nonstaining when tested per ASTM C1248.

1. Manufacturers and Products:

    a. Dow DOWSIL 756 SMS.
    b. GE Construction Sealants SCS9000 SilPruf NB.
    c. Pecora Corporation 864NST.
    d. Tremco Spectrem 3.

2. Colors: Architect selected.

2.3 EXTERIOR CONCEALED SEALANTS

A. Butyl Sealant: ASTM C1311.

1. Manufacturers and Products:

    a. Pecora Corporation BC-158.
    b. Tremco Butyl Sealant.
    c. C.R. Laurence 888.

2.4 INTERIOR SEALANTS AND CAULKING

A. Interior Color Sealant: Silane-modified polymer sealant or urethane; ASTM C920, S, Grade NS, Class 50, Uses T and NT.

1. Manufacturers and Products:

    a. Master Builders Solutions MasterSeal NP2.
    b. Pecora Corporation DynaTrol I XL Hybrid.
    c. Sika Corporation Sikaflex 2c NS EZ Mix.
    d. Tremco Dymeric 240FC.

2. Colors: Architect selected.
3. Applications:

    a. Interior joints noted as‘sealant’ on Drawings.

B. Paintable Caulking: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers and Products:

    a. Master Builders Solutions MasterSeal NP 520.
    b. Pecora Corporation AC20.
    c. Tremco Tremflex 834.

2. Applications:

    a. Interior joints noted as 'caulking.'
    b. Joints, crevices, and irregularities wider than hairline joints in or between dissimilar materials or painted surfaces.

c. Perimeters of door frames, frames and trim for glazing, and frames or trim for other wall and ceiling openings at painted surfaces.

2.5 INSTALLATION ACCESSORIES

A. Primer: As required by sealant manufacturer.

B. Backer Rod: ASTM C1330, Type C, closed-cell or Type O, open-cell, as recommended by sealant manufacturer.

C. Bond Breaker Tape: Self-adhesive plastic tape to prevent sealant from adhering to back of joint.

D. Cleaners: As recommended by sealant manufacturer.

E. Masking: Non-staining, self-adhesive.

2.6 MIXES

A. Multicomponent Sealants: Mix tinting colorant with base sealant to uniform consistency and custom color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean joint surfaces for optimum adhesion. Remove dirt, moisture, and incompatible substances.

B. Existing Joints: Cut out and remove existing joint sealants down to original substrate. Small amounts of elastomeric sealants left in surface irregularities of concrete and masonry may be left in place subject to Architect’s approval, provided that they are securely bonded to surface, are compatible with new sealant, and are tested to demonstrate that suitable adhesion with new sealant can be achieved. Where these conditions cannot be met, remove existing sealants completely.

C. Prime joint surfaces where recommended by sealant manufacturer. Protect adjacent surfaces from misapplication or spillage of primer.

D. Mask surfaces adjacent to joints to receive elastomeric sealants. Remove masking after tooling.

3.2 INSTALLATION

A. Installation Reference Standard: Follow ASTM C1193.

B. General Installation Requirements:

1. Exterior Joint Sealants: Provide continuous, weatherproof seals to prevent infiltration of air and water through the joints.
2. Interior Joint Sealants: Provide continuous seals to prevent air infiltration through the joints in which they are installed.
3. Appearance: Apply sealants with smooth surfaces free of gaps, voids, bubbles, lumps, crevices, runs, drips, striations, and other irregularities.

C. Set joint filler units at uniform depths in joints to support sealants and maintain proper sealant cross-section shape and depth within the following general limitations, measured at center (thin) section of beads.

1. Pavement Joints: Sealant depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
2. Other Joints: Sealant depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.

D. Set joint filler for sealant neck dimension of maximum 1/3 of joint width.

E. Install joint fillers under compression and friction fit. Do not install filler units that have absorbed water.

1. Do not leave voids or gaps between ends of joint filler units.
2. Do not stretch, twist, puncture, or tear joint fillers.
3. Remove joint fillers that have absorbed moisture or which have ruptured gas cells and install suitable new fillers before sealant application.

F. Install bond breaker tape where indicated or where joint filler is not used to prevent adhesion to back of joint.

G. Deposit sealants in uniform, continuous ribbons without gaps and air pockets.

H. Tool sealants to ensure full adhesion. Form smooth, slightly concave surface.

I. Cure joint sealants.

3.3 CLEANING

A. Clean spills, misapplications, and material migrations immediately as they occur.

B. Clean marred surfaces by whatever means are necessary to eliminate evidence of spillage.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. New exterior door in hollow metal frame.

B. Principal Products

1. Hollow metal doors
2. Hollow metal frames

1.2 ACTION SUBMITTALS

A. Product Data.

1. Hollow metal doors and frames.

B. Shop Drawings: Show construction, sizes, configurations, reinforcements, anchorages, installation details.

1. Door elevations showing cutouts.
2. Door frame elevations.
3. Hardware mounting locations.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing thermal performance.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: SDI Certified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store and handle door frames maintaining spreader bars in place until installation.

1.6 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 EXTERIOR DOORS AND FRAMES - EXTRA HEAVY DUTY

A. Doors: ANSI/SDI A250.8; 1-3/4 inch thick.

1. Classification: Level 3, Physical Performance Level A.
2. Model: 2, seamless.
3. Faces: Steel sheet, 0.053 inch thick, A60 coating.
4. Core: Insulated.
5. Top and Bottom Edges: Closure channel, top edge sealed watertight.

B. Frames: ANSI/SDI A250.8.

1. Material: Steel sheet, 0.053 inch thick, coating matching door face.
2. Construction: Face welded, mitered corners.
3. Thermal Break: Manufacturer standard.

2.2 PERFORMANCE

A. Environmental Performance: Exterior doors.

1. Air Infiltration: AAMA/WDMA/CSA 101/I.S.2/A440; 0.30 cfm/sf, maximum at 6.24 psf pressure differential.
2. Water Penetration: AAMA/WDMA/CSA 101/I.S.2/A440; no leakage at 9.19 psf pressure differential.
3. Thermal Transmission: U-0.61, maximum.

2.3 MATERIALS

A. Steel Sheet: ASTM A653/A653M; hot-dipped galvanealed coating.

B. Insulation:

1. Door Core: Polyurethane or polystyrene.
2. Door Frame: ASTM C665, Type 1, unfaced mineral fiber.

C. Fasteners: Manufacturer's standard, Type 316 stainless steel.

2.4 FABRICATION

A. Fabricate doors and frames with hardware reinforcement welded in place.

1. Reinforce doors and frames for surface applied hardware without through bolting.
2. Hardware Locations: ANSI A250.8.

B. Door Edges: Beveled.

C. Fabrication Tolerances: SDI-117

2.5 FINISHES

A. Primer Materials: ANSI/SDI A250.10, rust inhibiting.

2.6 ACCESSORIES

A. Galvanizing Repair Materials: ASTM A780/A780M.

B. Weatherstripping: See Section 08 71 00.

C. Silencers: See Section 08 71 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify opening sizes are within tolerance limits.

3.2 INSTALLATION

A. Install doors and frames. Follow ANSI/SDI A250.8.

B. Interface with Other Work:

1. Coordinate door frame and anchor installation with masonry jamb construction.
2. Coordinate door and frame installation with door hardware installation.

C. Installation Tolerances: SDI-117.

D. Repair damaged zinc coatings. Follow ASTM A780/A780M.

E. Seal door frames to adjacent wall construction. See Section 07 92 00.

F. Field paint doors and frames. See Section 09 90 00.

3.3 REINSTALLATION

A. Reinstall existing doors and frames at new location.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Insulated overhead coiling door.

B. Principal Products:

1. Motorized coiling door

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate installation of work for support and anchorage of overhead coiling doors.
2. Coordinate power and control wiring for electrically operated doors.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Installers of power and control wiring.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Each type of overhead coiling door, including tracks and hardware.
2. Motor operators, controls, obstruction detection devices.

B. Shop Drawings.

1. Each type of overhead coiling door.
2. Support and anchorage details.
3. Schedule of overhead doors.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Warranty documentation.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Factory trained and authorized.

1.6 WARRANTY

A. Manufacturer Warranty: Warrant doors against defects in material and workmanship.

1. Warranty Period: 2 years.

PART 2 - PRODUCTS

2.1 EXTERIOR OVERHEAD COILING DOORS

A. Insulated Exterior Overhead Coiling Doors:

1. Manufacturers and Products:

a. Overhead Door Corp Model 625.
b. C.H.I. Overhead Doors Series 6000 Insulated Service Doors.
c. Clopay Building Products CESD20 Insulated Heavy Duty Service Door.
d. CornellCookson Thermiser Max.
e. McKeon ClimateGuard IS3000 Series.

B. Operation Cycles: 20 cycles per day; 20,000, minimum, cumulative with tamperproof counter.

C. Air Infiltration: 1.0 cfm/sq ft, maximum at 25 mph wind speed as tested per ASTM E283.

D. Door Curtain:

1. Slats: Flat, 2-5/8 inch wide.
2. Material: Extruded aluminum.
3. Insulation: Minimum R-7.
4. Interior Facing: Same material and finish as exterior
5. Perimeter Weather Seals: Replaceable resilient gaskets.
6. Finish: Factory-applied baked enamel on curtains and components visible when door is in fully open (retracted) position..

a. Color: Architect selected.

E. Operation: Electric.

2.2 COMMON COMPONENTS

A. Hood:

1. Material, Finish: Same as curtain.
2. Shape: Rounded.

B. Bottom Bars:

1. Material, Finish: Extruded aluminum, 1/8 inch minimum thickness.
2. Supply sloped bottom bar at doorways with cross-slope pavement.

C. Jamb Guides:

1. Material, Finish: Aluminum.
2. Endlocks: Manufacturer recommended for door size and operation.

D. Counterbalance: Adjustable enclosed helical torsion spring with grease sealed ball bearings or self-lubricating graphite bearings for rotating members.

E. Motor Operators:

1. Gear reduced type, mounted on head shaft.
2. Sufficient power to operate door between 9 and 12 inches per second.
3. Manually operable in case of power failure.
4. Electrical characteristics: 115/230 VAC, single phase, 60 Hz.
5. Disconnect Switch: Factory mounted on equipment.

F. Controls:

1. Control Station: Surface mounted.
2. Automatic Re-Opening: Electric sensing strip on bottom bar and photoelectric sensors that immediately stop downward travel and reverse direction to fully opened position when obstruction is detected.

2.3 PERFORMANCE

A. Wind Loads: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that work for structural support and anchorage is adequate.

3.2 INSTALLATION

A. Install doors plumb and parallel to supporting walls.

B. Anchor door tracks and operators rigidly and securely to prevent movement during door operation.

C. Install doors to operate smoothly without binding or distortion.

D. Install perimeter gaskets to provide continuous seals and for uniform compression.

E. Electrically-Operated Doors:

1. Make wiring connections between power supply and operator and between operator and controls.
2. Adjust limit switches for accurate movement.
3. Adjust obstruction detection controls.

3.3 FIELD QUALITY CONTROL

A. Testing:

1. Test obstruction detection controls.

B. Non-Conforming Work: Make corrections or replace, and re-test.

3.4 CLEANING

A. Clean factory-primed surfaces of soiling and substances that affect subsequent finish painting.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Coordinate demonstration with Owner's staff.

1. Demonstrate operation and maintenance of electrically-operated doors.

END OF SECTION

SECTION 08 41 13
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Fixed aluminum storefront framing with glass

B. Principal Products

1. Storefront framing

1.2 ACTION SUBMITTALS

A. Product Data:

1. Storefront framing, included tested performances.

B. Shop Drawings:

1. Plans and elevations for each installation.
2. Details of anchorage and support.
3. Details for continuity of air and water barrier with adjacent construction.
4. Details of flashing and internal drainage.
5. Provisions for thermal expansion and deflection.
6. Details of trim.
7. Details of extruded sills .

C. Samples:

1. Typical Framing Member: 12 inches long in required finish.

1.3 INFORMATIONAL SUBMITTALS

A. Impact Resistance Data:

1. Manufacturer’s current Florida Product Approval Number indicating product acceptance, as tested for large and small missile impact per ASTM E1886 and ASTM E1996 as modified by the FBC for design wind speeds.

    a. Openings Within 30 ft of Grade: Large missile test.
    b. Openings Above 30 ft of Grade: Small missile test.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For framing system.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Trained by system manufacturer.

B. Impact Test Labeling:

1. Provide labels on storefront framing required to be tested for impact resistance rating per requirements of authorities having jurisdiction..
2. Labels: Permanent metal labels, readily visible but inconspicuous from general view.
3. Label Information:

a. Manufacturer identification.
b. Model number.
c. Serial number or definitive information describing product performance characteristics.
d. Approved agency's identification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements: Follow AAMA CW-10.

1. Protect aluminum components from bending and from impact, abrasion, and other harmful contacts.
2. Maintain factory applied finish protections intact until time removal is recommended by manufacturer.

1.7 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer Warranty: Repair or replace components that do not comply with requirements or that fail in materials or workmanship.

1. Failures under design conditions specified in performance requirements.

a. Breakage or loss of glass.
b. Permanent deformation of components or assemblies.
c. Water penetration through fixed glazing.

2. Warranty Period: Five years.

B. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

A. Description: Extruded aluminum framing system, reinforced to support loads.

B. Exterior Storefront: Thermally broken and impact resistant.

1. Manufacturers and Products:

a. EFCO Corporation Series 526.
b. Kawneer IR 501UT.
c. Oldcastle BuildingEnvelope FG-5100T StormMax.
d. YKK AP YHS 50 TU.

2. Construction: Thermally broken.
3. Glass Installation: 4-side captured, installed fromexterior.
4. Glazing Plane: Center.
5. Finish: Color coating.

C. Sills: Extruded aluminum, finished same as framing.

D. Stools: Extruded aluminum finished same as framing.

E. Formed Trim: Aluminum sheet, 0.060 inch minimum thickness, finished same as framing.

F. Exposed Flashing: Aluminum sheet, 0.060 inch minimum thickness, finished same as framing.

2.2 GLAZING

A. Glass: Specified in Section 08 80 00.

B. Glazing Gaskets:

1. Material: Silicone; PVC not permitted.
2. Color: Black.

2.3 PERFORMANCE

A. Structural Loads: See Drawings.

B. Deflection: At design wind speed.

1. Perpendicular to Wall: 1/180 of span, not to exceed 3/4 inch edge of glass deflection.
2. Parallel to Glass Plane: 1/360 of span, not to exceed 1/8 inch.

C. Wind Movement: Design to criteria stated on Structural Drawings.

D. Wind-Borne Debris Resistance:

1. Florida Non-High Velocity Hurricane Zone product approval.

E. Environmental Performance:

1. Air Infiltration: ASTM E283.

a. Fixed Framing and Glass: 0.06 cfm/sq. ft., maximum at 1.57 lbf/sq.ft. static air pressure differential.

2. Water Penetration: ASTM E331

a. Fixed Framing and Glass: No water at 10.0 lbf/sq.ft. static air pressure differential.

3. Thermal Transmission: NFRC 100; 0.38 U-Factor, maximum.
4. Condensation Resistance: NFRC 500; 45, minimum.
5. Solar Heat Gain Coefficient: NFRC 200; 0.36, maximum.
6. Expansion and Contraction: Withstand thermal cycling over 120 degrees F ambient temperature and 180 degrees F on material surfaces.

2.4 MATERIALS

A. Aluminum: Manufacturer's recommended alloy and temper.

1. Extruded Profiles: ASTM B221.
2. Sheet and Plate: ASTM B209.
3. Structural Items: ASTM B308.

B. Steel Reinforcement: Manufacturer's recommended coating to prevent galvanic reaction with aluminum framing.

1. Structural Shapes: ASTM A36/A36M.
2. Cold-Rolled Shapes: ASTM A1008/A1008M.
3. Hot-Rolled Shapes: ASTM A1011/A1011M

C. Concealed Flashing: Dead-soft stainless steel 0.018 inch thick.

D. Assembly Sealants: Silicone.

E. Fasteners: Stainless steel.

1. Where exposed or semi-exposed, use countersunk flathead screws finished to match adjacent surface.

F. Separation Coating: Bituminous paint; SSPC-Paint 12.

G. Concrete Anchors: Group 1 stainless steel expansion anchors.

2.5 FABRICATION

A. Fabricate components for uniform 1/2 inch shim space at jambs and heads.

B. Fabricate joints flush, hairline, and weathertight.

C. Provide internal reinforcements needed for performance requirements.

D. Maintain thermal break of exterior assemblies.

E. Conceal fasteners and attachments from view.

F. Provide flat closure plates for open channel perimeter frame members.

G. Fabricate sheet metal components per SMACNA Architectural Sheet Metal Manual.

1. Fabricate trim and flashing in lengths to minimize number of joints.
2. Fabricate trim to uniform sizes and profiles with smooth, flat surfaces free of oil-canning or other distortion.
3. Fabricate trim for concealed anchorage where possible.

H. Provide continuity of drainage for condensation and infiltrated water to system weeps.

I. Fabrication Tolerances:

1. Square: 1/8 inch maximum difference in diagonal measurements.
2. Corner, Face Offsets: 1/32 inch maximum.
3. Bow in Framing Members: 1/16 inch maximum.
4. Joints: Hairline at permanent connections, 1/32 inch maximum at removable glazing stops.

2.6 FINISHES

A. Color Coating: Two-coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

1. Color: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that adjoining air and water barriers are in place and extend into rough openings beyond location of exterior joint seals.

3.2 PREPARATION

A. Separation Coating: Apply bituminous paint to surfaces that will contact dissimilar metals, masonry, or preservative-treated wood, or provide other permanent isolation material.

3.3 INSTALLATION

A. Do not install damaged or substandard components, including items that have deficient finishes.

1. Corrections in field are subject to Architect's approval before installation.
2. Return components to factory for remanufacturing or refinishing, or provide new components to replace items that cannot be satisfactorily corrected in field.

B. Coordinate attachment and sealing of exterior assemblies to air and water barrier materials to ensure continuity.

C. Install assemblies plumb, level, square, and accurately aligned.

D. Anchor assemblies securely to structural elements.

E. Set sill members with two lines of continuous sealant per Section 07 92 00.

F. Install flashing with end dams. Lap joints minimum 6 inches and seal watertight. Secure flashing with non-penetrating anchorages.

G. Fill shim spaces with mineral fiber or spray poyurethane foam insulation.

H. Remove debris, dirt, aluminum scraps, and other materials from glazing channels.

I. Verify that internal drainage and weeps are fully functional.

J. Glass Installation: Section 08 80 00.

K. Tolerances:

1. Variance from Plumb, Plane, and Level: 1/8 inch in 10 feet and 1/4 inch in 40 feet, maximum.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage agency to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Verify that sealants have cured fully before testing.
2. Perform tests before interior wall finishes installation.
3. Failed Test Retest Cost: Contractor responsibility.

B. Water Spray Test: AAMA 501.2.

1. Initial Test Location: Architect designated area of storefront.
2. Additional Locations: Test two additional Architect designated areas during remaining installation period.
3. Pass Criteria: No water penetration.

C. Air Infiltration Testing: AAMA 503.

1. Locations: Water resistance test locations.
2. Test Pressure: Specified in Performance article.
3. Allowable Leakage: 1.5 times rate specified in Performance article per ASTM E283.

D. Non-Conforming Work: Remove and replace, and re-test.

3.5 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Wash surfaces as recommended by storefront and sealant manufacturers.

C. Remove excess sealant.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Hardware for swinging doors.

B. Principal Products

1. Hinges.
2. Exit devices.
3. Closers.
4. Weatherstripping and thresholds.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate door and frame preparation to accommodate door hardware installation.

a. Provide door and frame preparation templates.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Door and frame installers.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include catalog cuts indicating materials, construction, finishes, functions, and specified options.

B. Shop Drawings:

1. Show hardware locations and mounting heights.

C. Schedules:

1. Hardware schedule for each opening using specified hardware set numbers.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operating hardware, including lubrication requirements, inspection procedures, and preventative maintenance.

B. Warranty Documentation: For exit devices and closers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Tools: Manufacturer's recommended special tools required to maintain hardware.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Package hardware items individually with necessary fasteners, instructions, and installation templates.
2. Label packages with door hardware schedule opening code.
3. Store hardware indoors, secured from theft.

1.7 WARRANTY

A. Manufacturer Warranty:

1. Warrant against product failure.

a. Closer Warranty Period: 10 years.
b. Exit Device Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 HARDWARE COMPONENTS

A. Hinges: ANSI A156.1, full mortise type.

1. Manufacturers:

a. Ives.
b. McKinney.
c. Hager.

2. Width: 4-1/2 inches minimum; permit 180 degree door swing.
3. Height and Weight: 4.5 inches minimum, extra heavy weight.
4. Number per Door Leaf: Three.
5. Pins: Non-removable pins (NRP).
6. Tips: Flat button with matching plug.

B. Exit Devices: ANSI/BHMA A156.3, Grade 1; standard strike with extended lip to protect trim from latch bolt.

1. Manufacturers and Products:

a. Von Duprin 99 Series.
b. Sargent 8800 Series.
c. Corbin-Russwin ED5000 Series.

2. Type: Rim.

C. Closers: ANSI/BHMA A156.4; full rack and pinion type with steel spring and non-freezing hydraulic fluid.

1. Manufacturers and Products:

a. LCN 4040XP Series.
b. Sargent 351 Series.
c. Norton 7500 Series.

2. Adjustability: Controllable closing and latching speeds and back checking.
3. Arms: Type to suit individual condition; parallel-arm.
4. Location: Mount closers on inside of exterior doors, room side of interior doors typical, pull side of other doors.
5. Operating Pressure:

a. Exterior Doors: 10 pounds, maximum.

6. Full Covers: Provide at overhead surface mounted closers.

D. Overhead Stops: ANSI/BHMA A156.8, Grade 1.

1. Manufacturers and Products:

a. Glynn-Johnson 90S Series.
b. Rockwood OH900S Series.
c. Hager 7000 Series.

2. Length: Selected for door width.

E. Kickplates: ANSI A156.6; 0.050 inch thick.

1. Manufacturers and Products:

a. Ives 8400 Series.
b. Rockwood K1050 Series.
c. Hager 190S Series.

2. Length: 2 inches less door width.

F. Thermal Bumper Thresholds: BHMA A156.21; aluminum, thermally broken, resilient thermal insert; fabricated to full width of opening.

1. Manufacturers and Products:

a. Pemko 274x224AFGT.
b. National Guard Products 8633N.
c. Reese S483.

2. Accessibility: Comply with ANSI A117.1

G. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length.

1. Manufacturers and Products:

a. Pemko S88BL
b. National Guard Products 5050
c. Zero 188S.

2.2 ACCESSORIES

A. Fasteners: Furnish hardware items with machine screws required for installation.

1. Through bolts are not permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify doors and frames are ready to receive door hardware.

3.2 INSTALLATION

A. Mounting Heights: Per door manufacturer instructions.

B. Install hardware plumb, level, and true to line and location.

C. Secure hardware with required fasteners located per installation templates.

3.3 PROTECTION

A. Protect hardware from damage.

3.4 SCHEDULES - GENERAL

A. Hardware sets establish type and standard of quality together with specified requirements. Examine Drawings and Specifications. Provide proper hardware for door openings.

3.5 SCHEDULE - EXTERIOR DOORS

A. Hardware Set:

1. Application: Exit at Grade.
2. Type: Single, HM x HM, unrated.
3. Hardware:

Qty	Product	Description	Finish
3	Hinges	Heavy Weight	630
1	Exit Device	Rim, Exit Only	630
1	Closer		689
1	Overhead Stop	Surface Mounted	630
1	Kickplate	0.050" x 10" x 2" LDW	630
1	Threshold		628
1	Set Seals		628
1	Door Sweep		628
Notes:			

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Glass for aluminum-framed storefront windows

B. Principal Products

1. Insulating glazing units.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting at project site in conjunction with preinstallation meetings for fenestration framing systems.
2. Agenda Items:

a. Coordinate schedules and material deliveries.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Each type of glass.

B. Samples: 12- by 12-inch samples of each glass type except clear monolithic.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For insulating glass.

1.5 FIELD CONDITIONS

A. Ambient Conditions:

1. Temperature: Minimum 40 degrees F and rising.
2. Install glass only on when glazing frames are free of moisture, including condensation, frost, and ice.

1.6 WARRANTY

A. Manufacturer Warranty:

1. Laminated Glass: Warrant against edge separation, delamination, or other defects.

a. Warranty Period: 5 years.

2. Insulating Glass: Warrant against the following:

a. Edge seal failure.
b. Internal condensation that does not dissipate.
c. Spacer delamination.
d. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 BASE GLASS

A. Clear Glass: ASTM C1036, Type I, Class 1, Quality-Q3.

2.2 HEAT TREATED GLASS

A. Heat Treated Glass: ASTM C1048, Type 1, Quality Q3; free of mosaic or pattern distortion visible from fixed viewpoint and other defects caused by roller pick.

1. Heat Strengthened Glass: Kind HS.
2. Tempered Glass: Kind FT.

B. Roll Ripple (Surface Wave) Tolerances:

1. Heat Strengthened Glass: 0.002 inch, maximum.
2. Tempered Glass: 0.005 inch, maximum.

C. Roll Ripple Orientation: Horizontal.

D. Fabricate heat-treated units with permanent label in consistent location at either lower corner.

2.3 COATED GLASS

A. Vacuum Deposition Coated Glass: ASTM C1376.

1. Color and Performance Attributes: See glass schedule.
2. Insulating Glass: Delete or omit coating from glass edges where spacer sealant is applied.

2.4 INSULATING GLASS

A. Insulating Glass Units (IGU): Factory assembled double-pane units tested per ASTM E2190 and certified by IGCC.

B. Warm Edge Spacer Strips: Rigid plastic or stainless steel with desiccant fill.

1. Manufacturers and Products:

a. Quanex Building Products Duraseal.
b. Technoform TGI-Spacer M.
c. Viracon VTS.
d. Vitro Intercept.

C. Space Fill: Dehydrated argon.

D. Edge Seals:

1. Primary Seal: Polyisobutylene.
2. Secondary Seal: Silicone.

2.5 LAMINATED GLASS

A. Laminated Glass: Two glass plies permanently bonded with interlayer; ASTM C1172.

1. Glass Plies: Heat-strengthened glass.
2. Interlayer Type: ionomeric polymer cast-in-place cured resin.
3. Interlayer Thickness:

a. Windborne Debris Impact Resistance: 0.060 inch.

4. Interlayer Appearance: Clear.

2.6 GLASS TYPES

A. Exterior Glass: Insulating unit.

1. Outer Lite: 6 mm fully tempered glass.

a. Tint: Clear.
b. Vacuum Deposition Coating: Low-E, #2 surface.

2. Air Space: 1/2 inch.
3. Inner Lite: Laminated glass.

a. Glass: Two layers 6 mm heat-strengthened glass.
b. Interlayer: 0.060 inch.
c. Tint: Clear.

4. Optical and Thermal Performance:

a. Visible Light Transmittance: 68 percent, minimum.
b. Exterior Reflectance: 11 percent, maximum.
c. Winter U-Factor: 0.28, maximum.
d. Solar Heat Gain Coefficient: 0.38, maximum.

2.7 INSTALLATION MATERIALS

A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 80 to 90 Shore A durometer hardness.

B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.

C. Glazing Gaskets: Specified with framing system.

2.8 PERFORMANCE

A. Wind-Borne Debris Resistance:

1. ASTM E1886 missile impact and cyclic-pressure for Wind Zone 1per ASTM E1996.

2.9 FABRICATION

A. Perform fabrication before delivering glass to site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Framing is ready to receive glazing.
2. Weep systems are unblocked and functional.
3. Face and edge clearances are sufficient.
4. Framing joints are properly sealed.

B. Examine glass lites for damage and defects before installation.

C. Do not install tempered glass with noticeable roller pick optical distortion.

3.2 PREPARATION

A. Clean glazing channels and rabbets; remove loose materials and moisture.

B. Remove protective coatings on metal surfaces.

C. Clean glass just before installation.

3.3 INSTALLATION - GENERAL

A. Install glass without direct contact on framing surfaces.

B. Maintain manufacturer recommended edge and face clearances between glass and frame members.

C. Set glass centered in openings on setting blocks.

D. Provide edge blocking needed to prevent sideways movement of glass in framing.

E. Set glass with correct orientation of exterior side.

3.4 INSTALLATION - GASKET GLAZING

A. Fabricate gaskets to fit openings.

B. Install gaskets in single pieces on each side of opening with joints only at corners.

C. Where recommended by framing system manufacturer, seal corners watertight.

D. Compress gaskets to produce weathertight seal without causing bending stresses in glass.

3.5 CLEANING

A. Remove nonpermanent labels and clean surfaces after installation.

B. Clean glass on both sides shortly before inspection for Substantial Completion.

3.6 PROTECTION

A. Protect glass vulnerable to damage with streamers attached to framing.

B. Exterior Glass:

1. Protect glass from contact with contaminating substances.
2. Examine glass surfaces below concrete or masonry for alkaline deposits and dirt, and remove such soiling when observed.
3. Provide new replacement units for damaged glass, including glass with stains or etching that cannot be removed.

END OF SECTION

SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Prepare existing concrete slabs for the following flooring types:

   a. Resilient tile and sheet.

2. Test concrete floor slabs for moisture and alkalinity (pH).
3. Remediate concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.

B. Principal Products:

1. Testing apparatus
2. Patching and self-leveling compounds.
3. Remedial floor coatings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:

   a. Moisture and alkalinity (pH) limits and test methods.
   b. Manufacturer's required bond/compatibility test procedure.

2. Remedial Materials:

   a. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.

1.3 INFORMATIONAL SUBMITTALS

A. Testing Agency's Report:

1. Description of areas tested; include floor plans and photographs if helpful.
2. Summary of conditions encountered.
3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.

6. Include certification of accuracy by authorized official of testing agency.
7. Submit report to Architect not more than two business days after conclusion of testing.

B. Adhesive Bond and Compatibility Test Report.

C. Specimen Warranty: Issued by remedial material manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For remedial floor coatings.

1.5 QUALITY ASSURANCE

A. Testing Agency:Employ and pay for an independent testing agency to perform moisture and alkalinity (pH) testing.

1. Qualifications: Experienced in specified testing methods.
2. Contractor's Responsibility Relating to Independent Agency Testing:

a. Provide access for and cooperate with testing agency.
b. Confirm date of start of testing at least 10 days before actual start.
c. Allow at least 4 business days on site for testing agency activities.
d. Achieve and maintain specified ambient conditions.
e. Notify Owner when specified ambient conditions have been achieved and when testing will start.

B. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in manufacturer’s packaging; include installation instructions.

B. Keep materials from freezing.

1.7 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours before testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours before testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

2.1 FLOORING PREPARATION MATERIALS

A. Patching and Self-Leveling Compound:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being installed to thicknesses indicated and feathered to nothing at edges.
2. Compressive Strength: 4000 psi, minimum, after 28 days, per ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering or adhesive manufacturer's recommended product, suitable for the moisture and pH conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination.

1. Manufacturers and Products: Recommended by testing agency or one of the following:

a. ARDEX Engineered Cements; ARDEX MC ULTRA with ARDEX V 1000.
b. Custom Building Products; CustomTech Tech MVC with TechLevel 100.
c. Dependable Floor Products; VAPORSEAL-HM with Dependable SKIMFLOW ES.
d. Koster American Corporation; Koster VAP I 2000 with Koster SL Premium overlay.
e. LATICRETE International, Inc; NXT Vapor Reduction Coating with NXT Level.
f. MAPEI Planiseal VS with Mapei PlaniLevel 560.
g. UZIN; UZIN PE 460 with UZIN PE 280 and UZIN NC 150.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Follow ASTM F3010.

3.2 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency and ASTM F3010.

B. Perform following operations in the following order:

1. Perform preliminary cleaning.
2. Internal Relative Humidity Testing: 3 tests.
3. Alkalinity (pH) Tests: Perform in same locations as relative humidity tests.
4. Specified remediation, if required due to relative humidity test result.
5. Patching, smoothing, and leveling.
6. Other preparation specified in finish flooring sections.

7. Adhesive bond and compatibility test.
8. Protection.

C. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct before doing any other remediation; re-test after correction.
2. Excessive Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
3. Excessive Alkalinity (pH):

    a. If remedial floor coating is necessary to address excessive moisture, no additional remediation is required for pH.
    b. If an adhesive that is resistant to the pH level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.3 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents for cleaning.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Test in accordance with ASTM F2170 Procedure A. Calcium Chloride and electrical impedance or resistance testing may not be substituted.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

D. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

C. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

D. In the event that test values exceed floor covering manufacturer's limits, perform remediation. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.6 PREPARATION

A. See individual floor covering sections for additional requirements.

B. Comply with recommendations of testing agency.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

A. Mix and apply remedial floor coating.

1. Prohibit traffic during application.
2. Honor substrate control, isolation and expansion joints.
3. Prime substrate, and apply floor coating in layers as recommended by manufacturer.
4. Allow coating to cure before applying finish flooring.

3.9 PROTECTION

A. Cover prepared floors with building paper or other durable covering until finish flooring is installed.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Gypsum board partitions

B. Principal Products

1. Studs and tracks

1.2 ACTION SUBMITTALS

A. Product Data.

PART 2 - PRODUCTS

2.1 PARTITION FRAMING

A. Framing Members and Components - General: AISI S220, sheet steel.

1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.

B. Standard Studs and Tracks:

1. Depth: See Drawings.
2. Thickness: See Drawings.

C. Deflection Top Track: Provide one of the following:

1. Single Long-Leg Track: Steel top track with 2 times deflection plus 1 inch deep flanges; studs friction fit.
2. Single Slotted Track: Steel top track with 2 times deflection plus 1 inch deep slotted flanges; studs fastened through slots.
3. Double Track: Steel top track system with inside track fastened to studs and outside track fastened to structure.

    a. Outside Track: 2 times deflection plus 1 inch flanges.
    b. Inside Track: Flanges 1/2 inch shorter than outside track.

4. Steel Thickness: Match studs.

2.2 BACKING

A. Backing Materials - General: At Contractor's option, use manufactured flexible wood backing system and flat strap backing plates.

B. Manufactured, Preformed Sheet Steel Backing: 6 inch wide, 68 mil steel, formed to fit stud spacing.

1. Manufacturers and Products:

a. Perfect Wall, Inc. Flush-Mount Flat Reinforced Backing.

C. Wood Backing System: Fire-retardant treated wood and predrilled steel clips for fastening to steel studs.

1. Manufacturers and Products:

a. ClarkDietrich Danback.
b. Mantisgrip Mantisgrip Backing Clip.
c. SCAFCO Kiwk-Back.

D. Flat Strap Backing Plates: Steel sheet screwed to studs.

1. Width: As needed for secure anchorage of wall-mounted items, but not less than 6 inches.
2. Thickness: 33 mils minimum.

2.3 ACOUSTICAL ACCESSORIES

A. Acoustical Sealant: Section 09 29 00.

2.4 ACCESSORIES

A. Anchors: Types recommended by framing manufacturer for substrates.

B. Fasteners: ASTM C1002; Type S or GA-216; length to suit application.

C. Isolation Strips at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (#15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify rough-in utilities in are proper locations.

3.2 INSTALLATION - GENERAL

A. Installation Standard: Comply with ASTM C754.

3.3 INSTALLATION - PARTITION FRAMING

A. Framing to Structure: Extend partition framing to underside of structure. Attach ceiling track to structure.

B. Brace stud framing system rigid; attach bridging to prevent stud rotation.

C. Orient stud flanges the same direction within wall assembly.

D. Stud Spacing:

1. Single-Layer Applications: See Drawings.

E. Deflection Accommodation: Install deflection top track systems to prevent axial loading of finished assemblies.

3.4 INSTALLATION TOLERANCES

A. Deviation from Indicated Position: 1/8 inch in 10 feet, maximum.

B. Deviation from Plumb and Level: 1/8 inch in 12 feet, maximum.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Gypsum board partitions

B. Principal Products

1. Gypsum panels
2. Acoustic sealant and insulation

1.2 ACTION SUBMITTALS

A. Product Data.

1. Each type of gypsum board.
2. Trim accessories.
3. Sound attenuation blankets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Panel Products:

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.
4. USG Corporation.

2.2 GYPSUM BOARD FOR INTERIOR APPLICATIONS

A. Fire-Resistant Gypsum Board: ASTM C1396.

1. Core: 5/8 inch, Type X.

2.3 INSTALLATION MATERIALS

A. PVC Trim: ASTM C1047 and ASTM D3678.

1. Manufacturers:

    a. ClarkDietrich.
    b. Plastic Components, Inc.
    c. Trim-Tex Inc.

2. Shapes: Cornerbead.

B. Sound Attenuation Blankets: ASTM C665, Type I, unfaced semi rigid mineral wool or fiberglass, thickness shown on Drawings, sized for friction fit.

1. Thickness:

    a. Walls: 3 1/2 inches.

C. Acoustic Sealant: ASTM C834; nonsag, paintable, nonstaining, butyl-free, latex sealant. Supply fire rated sealant for use in fire rated assemblies.

1. Manufacturers and Products:

    a. Accumetric LLC BOSS 824 Acoustical Sound Sealant.
    b. GE Construction Sealants RCS20.
    c. Grabber Construction Products Acoustical Sealant GSC.
    d. Hilti, Inc. CP509 Smoke and Acoustical Sealant.
    e. Pecora Corporation AIS-919.
    f. Specified Technologies, Inc. Smoke N Sound Acoustical Sealant.
    g. USG Corporation SHEETROCK Acoustical Sealant.

D. Fasteners for Gypsum Board:

1. Metal Framing 33 mils Thick and Less: ASTM C1002, Type S.

E. Joint Materials:

1. Interior Gypsum Board: ASTM C475/C475M; products compatible with substrate and other coatings applied to surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations and sizes of framing supports for openings and penetrations.

B. Examine panels for moisture and mold; discard damaged panels.

3.2 INSTALLATION - ACOUSTICAL ACCESSORIES

A. Comply with ASTM C919 for locations of acoustical sealant beads. Close off sound-flanking paths around or through the work, including sealing of partitions above acoustical ceilings.

B. Do not install sound attenuation blankets until mechanical and electrical work within framing spaces is complete.

C. Fill framing spaces for complete coverage after gypsum board has been installed on one side of partition.

D. Fit sound attenuation blankets tight around cut openings and penetrations, and behind and around electrical and mechanical items within framing spaces.

E. Pack blankets around door and window frames, between jamb studs, in boxed headers, and in other voids.

F. Provide wires or other means of mechanical supports to maintain full coverage and prevent insulation displacement.

G. Where concealed acoustical sealant beads are required at floor line, apply sealant to clean floor surface first and set gypsum boards into wet sealant.

H. At other locations tool beads to ensure complete contact with joint surfaces. Where exposed, form smooth concave surface suitable for finish painting.

3.3 INSTALLATION - INTERIOR GYPSUM BOARD

A. Comply with ASTM C840.

B. Cut panels to fit obstructions and openings without tearing face paper or cracking core.

C. Install panels with face side out with lightly butted joints.

D. Stagger joints on opposite sides of partitions.

E. Locate panel ends over support framing.

F. Fit panels to ducts, pipes, conduit, and other penetrations and obstructions with maximum 1/4 inch joints.

G. Attach gypsum board to framing and to supplementary framing and blocking provided for additional support at openings and cutouts.

H. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

I. Isolate perimeter of non-loadbearing drywall partitions from structural members. Provide 1/4 to 1/2-inch space and trim edge with edge bead. Seal joints with acoustical sealant.

J. Single Layer Installation:

1. Install panels vertically with long edges on continuous supports.
2. Attach panels to framing with screws.

3.4 INSTALLATION - TRIM

A. Vertical Trim: Install in single pieces where length is 9 feet or less.

B. Control Joints: Install per ASTM C840 and as follows.

1. Locations of control and expansion joints in substrate or framing.
2. Walls:

a. At changes in backup material.

C. Corner Bead: Outside corners.

3.5 FINISHING

A. Reference Standard: ASTM C840.

B. Finish panel joints, inside corners, trim flanges, fastener heads, and surface defects to provide smooth, continuous surfaces of monolithic appearance that are suitable for applied finishes.

C. Finish Levels:

1. Level 4: Surfaces that receive flat or low sheen paint.

3.6 CLEANING

A. Remove spills, spatters, and misapplications of finishing materials as they occur.

B. Repair other finish surfaces damaged during drywall operations.

3.7 PROTECTION

A. Protection:

1. Protect adjacent surfaces from gypsum panel compounds, adhesives, and sealants
2. Protect finished gypsum panels from being marred from ongoing work.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Rubber flooring and wall base

B. Principal Products

1. Rubber floor tile
2. Rubber base

1.2 ACTION SUBMITTALS

A. Product Data:

1. Resilient flooring products.
2. Resilient accessories.
3. Installation materials.

B. Samples:

1. Resilient Tile Flooring: Full sized samples of each product.
2. Resilient Base: 12 inch length of each product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For resilient flooring.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Resilient Tile Flooring: One box.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store resilient flooring indoors and within ambient temperature range recommended by manufacturer.

2. Store resilient tile flooring on flat surfaces.

1.6 FIELD CONDITIONS

A. Ambient Conditions: Perform work within following limitations.

1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.
2. Establish ambient conditions 48 hours, minimum before and maintain conditions during and 48 hours, minimum after installation.

PART 2 - PRODUCTS

2.1 RESILIENT TILE FLOORING

A. Rubber Floor Tile: ASTM F1344.

1. Manufacturers and Products: See Finish Schedule on Drawings.

2.2 RESILIENT BASE

A. Rubber Base: ASTM F1861.

1. Manufacturers and Products: See Finish Schedule on Drawings.
2. Length: Coils.
3. Inside Corners: Job formed.
4. Outside Corners: Job formed.

2.3 INSTALLATION MATERIALS

A. Patching and Leveling Materials: Products recommended by flooring manufacturer for indicated substrates.

B. Edge Strips: Rubber; profiles shown on Drawings.

1. Colors: Architect selected.

C. Adhesives: Flooring and base manufacturer recommended water-based products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Moisture and Alkalinity Testing: See Section 09 05 61.

3.2 PREPARATION

A. Preparing Concrete Substrates: See Section 09 05 61.

3.3 TILE FLOORING INSTALLATION

A. Mix materials from multiple containers for consistent blend of colors.

B. Lay out tiles so that units at opposite walls are equal width and more than half size.

C. Extend tile into recesses and under equipment.

D. Terminate tile flooring at centerline of doors where adjacent floor finish is dissimilar.

E. Scribe and cut tile for close fit at vertical surfaces so that cut edge will be concealed by wall base or other trim.

F. Install tile with full adhesive coverage.

G. Roll tile to eliminate entrapped air and ensure full adhesion.

H. Install edge strips where tile terminates against dissimilar flooring. Butt end seams tight.

3.4 BASE INSTALLATION

A. Installation:

1. Form tight joints.
2. Align the tops of bases with adjacent units..
3. Ensure continuous contact between base and substrate. Fill voids between base and substrate with manufacturer recommended filler material.
4. Do not stretch base.

B. Job-Formed Corners:

1. Outside Corners: Form bends without discoloration in corners.
2. Inside Corners: Miter.

3.5 CLEANING AND PROTECTION

A. Remove excess adhesive.

B. Do not allow traffic on flooring until adhesives have fully set.

C. Provide surface protection during construction period.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Painting for CMU, gypsum board, and steel substrates

B. Principal Products

1. Primer.
2. Paint.

1.2 REFERENCES

A. Definitions:

1. Sheen Levels: ASTM D523.

a. Flat: Five gloss units at 60 degrees and 10 gloss units at 85 degrees, maximum.
b. Eggshell: 10 to 25 gloss units at 60 degrees and 10 to 35 gloss units at 85 degrees.
c. Satin: 20 to 35 gloss units at 60 degrees and 35 gloss units minimum at 85 degrees.
d. Semi-Gloss: 35 to 70 gloss units at 60 degrees.
e. Gloss: 70 gloss units at 60 degrees, minimum.

1.3 ACTION SUBMITTALS

A. Product Data.

B. Samples:

1. Draw Down Samples: Each type of paint system and each topcoat color and gloss.

a. Label each Sample for paint type, location, and substrate.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data:

1. Cleaning, touch-up, and repair instructions for painted and coated surfaces.
2. Area summary with finish schedule and color samples, designating where each product, color and finish was used.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Paint from same product run as installed materials.

a. Quantity: 5 percent, but not less than 1 gallon of each material and color.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store paint products in sealed containers until ready for use.

1.7 FIELD CONDITIONS

A. Apply materials only when surface and ambient temperatures are within temperature ranges required by paint product manufacturer.

B. Apply exterior coatings when rain or snow are not occurring or forecasted, and when relative humidity is inside humidity ranges, and moisture content of surfaces is within acceptable levels required by paint product manufacturer.

PART 2 - PRODUCTS

2.1 COLORS

A. Colors by Basis of Design Manufacturer Designations: See Finish Schedule on Drawings.

B. Products: Scheduled in this Section.

2.2 PAINT, GENERAL

A. Paint Systems: Primers, intermediate coats and topcoats compatible with substrates and one another.

B. Coatings: Ready mixed or field-catalyzed.

C. Preparation:

1. Mix to soft paste consistency, capable of being readily and uniformly dispersed to homogenous coating.
2. Blend tints and catalyzers to uniform consistency and color, capable of drying or curing free of streaks or sags.

2.3 SOURCE QUALITY CONTROL

A. Tests:

1. Testing: Owner may engage a qualified testing agency to sample paint materials delivered to project site or taken from supplier's facility.
2. Acceptance Criteria: Products comply with specified requirements.

B. Non-Conforming Work: Remove materials from substrates, pay for testing of replacement products, and repaint surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify substrates are ready to receive work.

B. Preinstallation Testing: Test moisture content of substrate does not exceed the following:

1. Masonry: 12 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board: Verify that finishing compound is dried and sanded smooth.

D. Masonry: Verify surface has cured at least 30 days and that the pH of the surface is between 6 and 9.

3.2 PREPARATION

A. Surface Preparation: Remove electrical plates, hardware, trim, escutcheons, and fittings. Correct defects in substrates capable of affecting work.

B. Cleaning: Remove substances that could impair paint bond, including dust, oil, grease, and incompatible coatings.

1. Impervious Surfaces: Remove mildew by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
2. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
3. CMU Surfaces: Remove dirt, loose mortar, scale, efflorescence and chalk. Remove oil and grease by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
4. Non-Passivated Galvanized Surfaces: Smooth and hand or power tool clean per ASTM D6386.
5. Passivated Galvanized Surfaces: Remove soluble and insoluble contaminants and corrosion. Sweep blast per ASTM D6386 to achieve uniform 1.0 to 2.0 mil anchor profile.
6. Primed Steel: Clean field welds, fasteners, and abraded shop primer.

3.3 APPLICATION

A. Follow manufacturer instructions for application method, thickness of coatings, and number of coats.

1. Apply finishes when surfaces are dry. Allow applied coats to dry before next coat is applied.
2. Apply each coat of paint slightly darker than preceding coat.
3. Apply coatings to uniform appearance.
4. Sand metal surfaces lightly between coats.
5. Leave testing agency, equipment identification, and performance labels unpainted.

B. Appearance:

1. Apply paints without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, or other imperfections.
2. Edges and Color Breaks: Produce sharp edges.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner may engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.

B. Testing: Dry film thickness.

C. Non-Conforming Work: Remove and replace or apply additional coats, and re-test.

3.5 CLEANING

A. Cleaning:

1. Remove rubbish, empty cans, rags, and other discarded materials.
2. Remove splattered paints. Protect adjacent surfaces from damage.

3.6 PROTECTION

A. Protection: Protect painted surfaces from subsequent construction work. Touch up and restore damaged painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Block Filler:

a. BEHR: Behr Pro Block Filler Primer, PR50.

b. Benjamin Moore: Corotech Waterborne Epoxy Block Filler 163
c. PPG Paints: Perma-Crete Concrete Block & Masonry Surfacer/Filler.
d. Sherwin-Williams: Pro Industrial Heavy Duty Block Filler, B42W00150.

2. Epoxy Topcoat: Semi-gloss finish.

a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic Coating.
b. Benjamin Moore: Corotech Surface Tolerant Epoxy Mastic V160.
c. PPG Paints: Amerlock 2/400.
d. Sherwin-Williams: Macropoxy 646.

B. Gypsum Board Walls:

1. Latex Primer:

a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. PPG Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer B28W02600.

2. Acrylic-Latex Enamel: Eggshell finish.

a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

C. Steel Doors and Frames:

1. Pre-Primed Metal: Touch up with same shop primer product used by manufacturer.
2. Acrylic-Latex Enamel: Semi-gloss finish.

a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 SG or 90 Series.
d. Sherwin-Williams: Pro Industrial Acrylic.

3.8 EXTERIOR PAINTING SCHEDULE

A. Shop-Primed Ferrous Metal: Pigmented polyurethane over high-build epoxy system.

1. Epoxy Primer:

a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic.
b. Benjamin Moore: Corotech Surface Tolerant Epoxy Mastic (V160).
c. PPG Paints: Amerlock 2/400.
d. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
e. Tnemec Series 135 Chembuild.

2. Polyurethane Topcoat: finish.

    a. BEHR: US Coatings UreGrip 3010 VOC HS Polyester Polyurethane.
    b. Benjamin Moore: Corotech Aliphatic Acrylic Urethane.
    c. PPG Paints: Pitthane Ultra Urethane Enamel 95-812.
    d. Sherwin-Williams: Hi-Solids Polyurethane B65-300.
    e. Tnemec: Series 73 Endura-Shield.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. Recessed fire extinguisher cabinets with dry chemical fire extinguishers.

B. Principal Products

1. Fire extinguisher cabinets.
2. Fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver fire protection specialties in manufacturer's undamaged packaging.

1.5 WARRANTY

A. Manufacturer Warranty:

1. Fire Extinguishers: Warrant against product failure.

a. Failure includes material and workmanship.
b. Warranty Period: Six years.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Fire Extinguishers - General:

1. Fire Extinguisher Fabrication and Labeling: NFPA 10:
2. FM Global approved.

B. Multipurpose Dry-Chemical:

1. Manufacturers and Products:

    a. Amerex Model B441.
    b. J.L. Industries Cosmic 10E
    c. Larsen's Manufacturing Company MP10
    d. Potter Roemer 3010.

2. UL Rating: 4A:80-B:C.
3. Nominal Capacity: 10 pounds.
4. Container: Enameled-steel container with chrome plated brass valve.

2.2 FIRE EXTINGUISHER CABINETS

A. Flush Framed Door Fire Extinguisher Cabinets:

1. Manufacturers and Products:

    a. Larsen's Manufacturing Company 2409 Series Architectural.
    b. J.L. Industries Cosmopolitan.
    c. Potter-Roemer Alta 7000 Series.

2. Cabinet: Cold rolled steel, sized for extinguisher; recessed type.

    a. Interior Finish: White baked enamel.

3. Door: Stainless steel, No. 4 finish.
4. Frames: Hollow metal, 1/2 inch thick.
5. Glazing: Vertical duo.
6. Glass Type: Tempered.

    a. Glass Color: Clear.

7. Hardware: Piano hinge and door pull.
8. Trim: Material to match door, rolled edge, depth to suit mounting conditions.

2.3 FABRICATION

A. Shop Fabrication: Provide cabinets with trim, frame, door, and hardware.

2.4 FINISHES

A. Shop Finishing Methods: Follow NAAMM's AMP 500.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify rough openings and blocking for cabinet are correctly sized and located.

3.2 INSTALLATION - GENERAL

A. General: NFPA 10.

B. Secure cabinets in place.

C. Place extinguishers in cabinets.

D. Apply signage.

3.3 ADJUSTING

A. Adjust fire protection cabinet doors for smooth operation.

3.4 CLEANING

A. Clean interior and exterior surfaces.

END OF SECTION

SECTION 10 51 00
LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results

1. New lockers and benches in existing classroom.

B. Principal Products

1. Metal lockers.
2. Wood locker benches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Locker types, sizes, hardware, and accessories.

B. Shop Drawings:

1. Locker plan layout with numbering.

C. Samples:

1. Metal Lockers: 6 by 6 inch in size, of each color on base metal.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Warranty documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Metal Lockers: Store inside building.

1.5 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.6 WARRANTY

A. Manufacturer Warranty:

1. Lockers: Warrant against product failure.

a. Warranty Period: 3 years, minimum.

PART 2 - PRODUCTS

2.1 METAL LOCKERS

A. Knocked-Down Athletic Lockers:

1. Manufacturers and Products:

a. Salisbury 70018.
b. Lyon LLC Collegiate.
c. Republic Storage Systems, Inc. MVP.

2. Configuration:

a. Tiers: Single.
b. Overall Height: 72 inches.
c. Width: 24 inches.
d. Depth: 18 inches.

3. Doors: None.
4. Sides and Dividers: 0.060 inch minimum Perforated or 0.090 inch expanded metal steel sheet welded to angle frame.
5. Compartments:

a. 12 by 12 inch lockable hinged compartment above top shelf.
b. Lift-top lockable foot locker.

6. Hinges: Knuckle butt hinges; welded to frames.
7. Locking: Padlock hasp.
8. Finish: Thermoset enamel or powder coating.

a. Color: Architect selected.

9. Number Plates: Aluminum.

B. Interior Accessories:

1. Coat Hooks: One prongs, steel.

    a. Quantity: Two per locker.

2. Hanging Bar: 1 inch diameter steel tube.

2.2 LOCKER BENCHES

A. Design: Movable pedestal supports.

1. Pedestals: Painted steel or Powder-coated aluminum; round posts.

B. Seats: Maple; clear finish.

2.3 MATERIALS

A. Wood: AWI 300.

2.4 FABRICATION

A. Complete locker fabrication before shipment to site.

B. Attach number identification plates.

2.5 FINISHES

A. Powder Coating: Thermoset polyester; AAMA 2603 but 1.5 mil minimum thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations and sizes of anchorage framing or backing.

3.2 LOCKER INSTALLATION

A. Knocked-Down Lockers: Assemble lockers square and without distortion.

B. Install lockers plumb, level, and aligned in plane.

C. Connect lockers into rigid, stable assemblies with flush, full contact joints.

D. Anchor lockers to floor and to adjacent walls.

3.3 BENCH INSTALLATION

A. Set movable benches in rooms.

3.4 ADJUSTING

A. Adjust doors for smooth, accurate movement and secure latching.

3.5 CLEANING

A. Cleaning: Clean interiors and exteriors of lockers.

3.6 PROTECTION

A. Do not use installed lockers for storing construction materials or clothing.

END OF SECTION

SECTION 10 71 13
EXTERIOR SUN CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Cantilevered horizontal aluminum sun shade outriggers with airfoil-shaped blades

B. Principal Products:

1. Fabricated aluminum sun shade

1.2 ACTION SUBMITTALS

A. Product Data.

B. Shop Drawings:

1. Include elevations, sections and specific details for each sunshade.
2. Show anchorage details and connections for all component parts.

C. Samples:

1. Metal finish, 3 by 3 inches, minimum.
2. Airfoil Blade: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Delegated Design Submittals:

1. Structural design of sun shades.

1.4 QUALITY ASSURANCE

A. Licensed Professionals: Engineer specializing in design of cantilevered sun shades, licensed in New Jersey.

1.5 WARRANTY

A. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.1 CANTILIEVERD SUN SHADES

A. Custom, Factory-Fabricated Aluminum Sun Shades:

1. Manufacturers:

a. Construction Specialties, Inc.
b. DAMS Incorporated.
c. AGS Shades, Inc.

2. Configuration: Match existing, or as shown on Drawings.
3. Finish: Color coating.

2.2 PERFORMANCE

A. Delegate exterior sun shades to manufacturer's licensed Professional Engineer.

B. Structural Loads:

1. Snow and Wind Loads: See Structural drawings.

2.3 MATERIALS

A. Aluminum: Manufacturer's recommended alloy and temper.

1. Extruded Profiles: ASTM B221.
2. Sheet and Plate: ASTM B209.
3. Structural Items: ASTM B308.

B. Fasteners: Stainless steel.

1. Where exposed or semi-exposed, use countersunk flathead screws finished to match adjacent surface.

C. Separation Coating: Bituminous paint; SSPC-Paint 12.

2.4 FABRICATION

A. Fabricate joints flush, hairline, and weathertight.

B. Provide internal reinforcements needed for performance requirements.

C. Conceal fasteners and attachments from view.

2.5 FINISHES

A. Color Coating: Two-coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

1. Color: Architect selected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structural members to receive sun shades. Verify dimensions and anchorage points.

B. Examine sun shades. Do not install warped, bowed, deformed or otherwise damaged or defaced members.

3.2 INSTALLATION

A. Anchor sunshades to the building substructure as indicated on approved shop drawings.

B. Set units level, plumb, and true to line, with uniform joints.

C. Installation Tolerances:

1. Variation From Plane or Location: 1/8 inch per 12 feet, but not exceeding 1/2 inch total, maximum.

3.3 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Clean exposed surfaces. Remove excess sealants.

3.4 PROTECTION

A. Protect installed sun shadesto prevent damage by subsequent construction operations.

END OF SECTION

SECTION 11 13 00
LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Principal Products

1. Rubber dock bumpers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Dock bumpers.

PART 2 - PRODUCTS

2.1 DOCK BUMPERS

A. Laminated Tread Dock Bumpers: Multiple plies from fiber-reinforced rubber tires laminated with two pressure rods at angle ends; minimum 1 inch projection beyond end angles.

1. Thickness: 4-1/2 inches.
2. Horizontal Type: 6 inches high by 14 inches long.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36.

B. Expansion Anchors: Stainless steel, sized per manufacturer recommendations.

2.3 FINISHES

A. Finish: Rust-inhibitive baked enamel or powder coat system.

1. Color: Black.

PART 3 - EXECUTION

3.1 INSTALLATION - DOCK BUMPERS

A. Install bumpers level and plumb.

B. Secure bumpers to dock structure with expansion anchors.

END OF SECTION

SECTION 14 42 00
WHEELCHAIR LIFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Self-contained vertical platform lift

B. Principal Products:

1. Platform lift

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week before starting work of this section.

a. Coordinate electrical work and connections to other construction.

B. Coordinate installation of concrete slab recess, lift travel distance with finish floor elevations on drawings, and electric service power characteristics and location, grounding connections.

1.3 ACTION SUBMITTALS

A. Product Data: Signal and operating fixtures, lift design, layout, components, and schematic of wiring diagrams.

1. Include color selection information.

B. Shop Drawings:

1. Indicate drive mechanism, lift construction, dimensions, control functions and operational description.
2. Show anchorages to building structure.

C. Samples: Painted finishes.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Submit parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Submit technical information for servicing operating equipment.

B. Manufacturer warranties.

C. Inspection certificates and operating permits.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer Warranty:

1. Warrant against drive train failure.

a. Warranty Period: 10 years.

2. Warrant against other parts failure.

a. Warranty Period: Four years.

PART 2 - PRODUCTS

2.1 INTERIOR WHEELCHAIR LIFTS

A. Self-Contained, Non-Enclosed Interior Wheelchair Lifts: ASME A18.1.

1. Manufacturers and Products:

a. Ascension Protégé; as basis of design
b. Garaventa Genesis OPAL
c. Savaria V-1504.

2. Rated Net Capacity: 750 lbs, minimum.
3. Rated Speed: 5 feet per minute, minimum
4. Travel Distance: See Drawings.
5. Nominal Platform Size: See Drawings.
6. Gate Type: Single, swing interlocking type, 42 inches high.

a. Gate Materials: Metal frames with 1/4 inch thick high impact strength clear plastic panels.

7. Features:

a. Ramps: None required or automatic folding type if ramps are part of system.
b. Automatic gate openers
c. Gate interlocks prevent lift operation unless gates are closed.
d. Manual Override: Hydraulic hand pump.

2.2 OPERATION AND SAFETY COMPONENTS

A. Upper and lower limit switches.

B. Brake: Electro-mechanical type applied automatically by restrained compression spring to hold lift in position, and released electrically.

C. Controls: push button controls located at top and bottom landings, enabling lift to be called or sent to landing.

D. Platform and Access Ramp Surfaces: Slip resistant, minimum 0.6 static coefficient of friction.

E. Key-lock on/off controls meeting requirements of ANSI A17.1, Part 2000.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:

1. 110 volts, single phase, 60 Hz., 24 volt control circuit.

B. Motor: NEMA MG1, instant reversing.

C. Disconnect Switch: Factory mount disconnect switch on equipment.

D. Battery Backup: Minimum five lift cycles at full load during power outage events.

2.4 FINISHES

A. Metal Finish: Thermoset enamel or powder coating; Architect selected color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify liftway and machine space are ready for work of this Section.

B. Verify required openings are of correct size and within tolerances.

C. Verify electrical power is available and of correct characteristics.

3.2 INSTALLATION

A. Install in accordance with ASME A17.1.

B. Install system components and connect to building utilities and electrical service.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.

B. Testing: Required by ASME A17.2.3.

1. Submit test and approval certificates issued by authorities having jurisdiction.

C. Non-Conforming Work: Make corrections or replace, and re-test.

3.4 ADJUSTING

A. Adjust automatic floor leveling feature at each stop to stop platform within 1/8 inch of finished floor.

B. Adjust for smooth operation.

3.5 CLEANING

A. Remove protective coverings from finished surfaces. Clean surfaces and components ready for inspection.

3.6 DEMONSTRATION

A. Demonstrate wheelchair lift operation and maintenance to Owner’s personnel.

3.7 PROTECTION

A. Do not allow wheelchair lift to be used for construction.

END OF SECTION

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Iron butterfly valves with indicators.
2. Check valves.
3. Iron OS&Y gate valves.
4. NRS gate valves.
5. Indicator posts.
6. Trim and drain valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Fire Main Equipment: HAMV - Main Level.

    a. Indicator Posts, Gate Valve: HCBZ - Level 1.
    b. Ball Valves, System Control: HLUG - Level 3.
    c. Butterfly Valves: HLXS - Level 3.
    d. Check Valves: HMER - Level 3.
    e. Gate Valves: HMRZ - Level 3.

2. Sprinkler System & Water Spray System Devices: VDGT - Main Level.

    a. Valves, Trim and Drain: VQGU - Level 1.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.

1) Gate valves.
2) Check valves
3) Miscellaneous valves.

C. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B31.9 for building services piping valves.

D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

E. NFPA Compliance for valves:

1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.

F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.

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

H. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 IRON BUTTERFLY VALVES WITH INDICATORS

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

1. .
2. .
3. .
4. .

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.4 CHECK VALVES

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

1. .
2. .
3. .
4. .

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.5 IRON OS&Y GATE VALVES

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

1. .
2. .
3. .
4. .
5. .

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).

2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.6 NRS GATE VALVES

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

1. .
2. .
3. .
4. .

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.7 INDICATOR POSTS

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

1. .
2. .
3. .
4. .

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground Upright.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.

5. Cap: Cast or ductile iron.
6. Operation: Wrench.

2.8 TRIM AND DRAIN VALVES

A. Ball Valves:

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

   a. .
   b. .
   c. .
   d. .

2. Description:

   a. Pressure Rating: 175 psig.
   b. Body Design: Two piece.
   c. Body Material: Forged brass or bronze.
   d. Port size: Full or standard.
   e. Seats: PTFE.
   f. Stem: Bronze or stainless steel.
   g. Ball: Chrome-plated brass.
   h. Actuator: Handlever.
   i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
   j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

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

   a. .
   b. .
   c. .

2. Description:

   a. Pressure Rating: 175 psig.
   b. Body Material: Brass or bronze.
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

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

   a. .
   b. .

2. Description:

   a. Pressure Rating: 175 psig.
   b. Body Material: Bronze with integral seat and screw-in bonnet.
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc Holder and Nut: Bronze.
   f. Disc Seat: Nitrile.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:

   1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping.
   2. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
   3. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
   4. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.
   5. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.

C. Install double-check valve assembly in each fire-protection water-supply connection.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

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

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.
3. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.

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

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL HANGER-SHIELD INSERTS

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

1. .
2. .
3. .
4. .

B. Insulation-Insert Material: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.

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

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.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. .
b. .
c. .
d. .

B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. .
b. .
c. .

2. Indoor Applications: Zinc-coated or Stainless steel.
3. Outdoor Applications: Stainless steel.

2.6 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

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

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. 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.

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

I. 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.

J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by 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.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of 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 bearing surface smooth.

C. 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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

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

B. Comply with NFPA requirements 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 finishes.

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

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. 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. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Comply with NFPA requirements.

L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Comply with NFPA requirements. 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.

N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Manual control stations.
6. Pressure gauges.

B. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
2. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

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

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which items of other systems and equipment are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For qualified Installer and professional engineer.

C. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Available fire-hydrant flow test records indicate the following conditions:

a. Date: 02/14/2019.
b. Performed by: Michael L Willis, PE of Suez Water.
c. Location of Residual Fire Hydrant R: #1-982 Charles Drive & Route 37 East.
d. Location of Flow Fire Hydrant F: #1-99 Cedar Grove Road & Charles Drive.
e. Static Pressure at Residual Fire Hydrant R: 55 psig.

f. Measured Flow at Flow Fire Hydrant F: 1996 gpm.
g. Residual Pressure at Residual Fire Hydrant R: 38 psig.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:
1) Building Service Areas: Ordinary Hazard, Group 1.
2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
3) Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
4) General Storage Areas: Ordinary Hazard, Group 1.
5) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
6) Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

4. Maximum protection area per sprinkler according to UL listing.
5. Maximum Protection Area per Sprinkler:
a. Office Spaces: 225 sq. ft..
b. Storage Areas: 130 sq. ft..
c. Mechanical Equipment Rooms: 130 sq. ft..
d. Electrical Equipment Rooms: 130 sq. ft..
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M thinwall with plain ends and wall thickness less than Schedule 10.

F. Hybrid Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.

G. Schedule 5 Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall with plain ends.

H. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

I. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.

J. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

K. Malleable- or Ductile-Iron Unions: UL 860.

L. Cast-Iron Flanges: ASME 16.1, Class 125.

M. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

N. Grooved-Joint, Steel-Pipe Appurtenances:

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

a. .
b. .
c. .
d. .

2. Pressure Rating: 175-psig minimum.
3. Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

O. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

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

a. .

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Specialty Valves Pressure Rating: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

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

a. .
b. .
c. .
d. .

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
5. Drip cup assembly pipe drain without valves and separate from main drain piping

G. Automatic (Ball Drip) Drain Valves:

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

a. .
b. .

2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.4 AIR VENT

A. Manual Air Vent/Valve:

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

a. .
b. .
c. .

2. Description: Ball valve that requires human intervention to vent air.
3. Body: Forged brass.
4. Ends: Threaded.
5. Minimize Size: 1/2 inch.
6. Minimum Water Working Pressure Rating: 300 psig.

B. Automatic Air Vent:

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

a. .
b. .
c. .

2. Description: Automatic air vent that automatically vents trapped air without human intervention.
3. Standard: UL listed or FM Global approved for wet-pipe fire sprinkler systems.
4. Vents oxygen continuously from system.
5. Float valve to prevent water discharge.
6. Minimum Water Working Pressure Rating: 175 psig.

C. Automatic Air Vent Assembly:

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

a. .
b. .
c. .

2. Description: Automaticair vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a prepiped assembly.
3. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
4. Vents oxygen continuously from system.
5. Float valve to prevent water discharge.
6. Minimum Water Working Pressure Rating: 175 psig.

2.5 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

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

a. .

b. .
c. .
d. .

2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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

a. .
b. .
c. .

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

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

a. .
b. .
c. .
d. .

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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

   a. .
   b. .
   c. .

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

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

   a. .
   b. .
   c. .
   d. .

2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

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

   a. .
   b. .
   c. .
   d. .

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.6 SPRINKLERS

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

1. .
2. .
3. .
4. .

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Automatic Sprinklers with Heat-Responsive Element:

1. Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice, quick response with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

F. Sprinkler Finishes: bronze.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

H. Sprinkler Guards:

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

a. .
b. .
c. .

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.8 PRESSURE GAUGES

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

1. .
2. .
3. .

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0- to 250-psig minimum.

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

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

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

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

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

E. Air Vent:

1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
2. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent. Do not retain the first subparagraph below if dual air vents are specified under "Automatic Air Vent Assembly" Paragraph above, or if air vent assembly configuration is such that the manufacturer does not require piping of the air vent to drain.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Thinwall, Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Thinwall, Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract 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.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

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, 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 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. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

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. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

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.

C. 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.

1.6 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.

1.7 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 Section “Access Doors and Frames.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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.

2.2 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.

2.3 JOINING MATERIALS

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

B. 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.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

I. Mechanically Formed Extruded Outlets in Copper Tube – “T-Drill”

1. Mechanically formed extruded outlets shall comply with the following:

a. ASME B31.9, ASTM F 2014-00, IPC 2015, IMC 2015, NSPC.

2. Mechanically formed extruded outlets shall be perpendicular to the axis of the run tube (header). They shall be formed by drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the branch wall.

3. Branch tubes shall not restrict the flow in the run tube. To ensure this by conforming the branch tube to the shape of the inner curve of the run tube, a dimple / depth stop shall be formed in the branch tube to ensure that penetration into the collar is of the correct depth. For inspection purposes, a second dimple shall be placed 0.25 inch above the first dimple. Dimples shall be aligned with the tube run.

4. Branches can be formed up to the run tube size as shown in ASTM F 2014. Forming procedures shall be in accordance with the tool manufacturer's recommendations.

5. Joints shall be made with the use of approved brazing alloys BCup2 thru BCup5 (0-15% silver content). brazed with a filler that has a melting point above 540 deg Centigrade (1000 deg F). Soft soldered joints are not allowed.

6. K, L, M and DWV copper types allowed.

7. Soft and Hard copper allowed.

8. Each model used for making branch connections shall be permanently marked with manufacturer's name and appropriate model number.

9. Mechanically formed extruded outlets can (but not limited to) be used on commercial and residential buildings.

10. Fitter / Plumber shall be trained and certified by "T-Drill" to operate the equipment.

2.4 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:

a. Cascade Waterworks Mfg. Co.
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.
g. Or approved equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC 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.
b. Or approved equal.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

    a. Thompson Plastics, Inc.
    b. Or approved equal.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

    a. NIBCO INC.
    b. NIBCO, Inc.; Chemtrol Div.
    c. Or approved equal.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities, Inc.
    e. Or approved equal.

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 Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Watts Industries, Inc.; Water Products Div.
    e. Or approved equal.

D. Dielectric-Flange Kits: 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.

1. Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.
    e. Or approved equal.

2. Separate companion flanges and steel bolts and nuts shall have 150-psig minimum working pressure where required to suit system pressures.

E. 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.
    c. Or approved equal.

F. 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.
    e. Or approved equal.

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. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.
    e. Or approved equal.

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: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length

required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 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.

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, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw and chrome-plated finish.

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

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

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 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.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

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.

O. 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.

P. Verify final equipment locations for roughing-in.

Q. 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 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.

E. 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.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

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 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.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Concrete base construction shall be as designed and specified by the structural contract documents.
2. Anchor equipment to concrete bases in accordance with contract documents and manufacturer’s written instructions.

3.6 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.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 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 22 05 00

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.

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

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

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

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.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. .
b. .
c. .
d. .

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. .
b. .
c. .
d. .
e. .

2. Indoor Applications: Zinc-coated or stainless steel.
3. Outdoor Applications: Stainless steel.

2.6 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

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

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. 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.

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

J. 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.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by 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.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of 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 bearing surface smooth.

C. 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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

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

B. Comply with MSS SP-58 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 finishes.

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

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

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

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. 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.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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 of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material test reports.

C. 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing 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 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping 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.

1.6 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

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. Comply with ASTM C552.

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

    a. Pittsburgh Corning Corporation.

2. Preformed Pipe Insulation: Type II, Class 1, without jacket.
3. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

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

    a. Aeroflex USA.
    b. Armacell LLC.
    c. K-Flex USA.

H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

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

    a. Johns Manville; a Berkshire Hathaway company.

b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials.

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

a. Armacell LLC.

2.2 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 Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

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

a. Foster Brand; H. B. Fuller Construction Products.

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

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

a. Aeroflex USA.
b. Armacell LLC.
c. Foster Brand; H. B. Fuller Construction Products.
d. K-Flex USA.

2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
3. Wet Flash Point: Below 0 deg F.
4. Service Temperature Range: 40 to 200 deg F.
5. Color: Black.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Mon-Eco Industries, Inc.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

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

a. Dow Consumer Solutions.
b. Johns Manville; a Berkshire Hathaway company.
c. P.I.C. Plastics, Inc.
d. Speedline Corporation.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Knauf Insulation.
d. Vimasco Corporation.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

c. Knauf Insulation.
d. Mon-Eco Industries, Inc.
e. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F Minus 20 to plus 180 deg F.
4. Color: White.

2.4 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Mon-Eco Industries, Inc.
d. Pittsburgh Corning Corporation.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F.
4. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Mon-Eco Industries, Inc.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

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

a. Childers Brand; H. B. Fuller Construction Products.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.5 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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, 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 D1784, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. P.I.C. Plastics, Inc.
c. Proto Corporation.
d. Speedline Corporation.

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.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

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

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
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 C1136.

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

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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

    a. Buckaroos, Inc.
    b. Just Manufacturing.
    c. McGuire Manufacturing.
    d. MVG Molded Products.
    e. Truebro.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

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

a. Truebro.
b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.

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 attached to structure with vapor-barrier mastic.
3. Install insert materials and 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 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 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 in similar fashion 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.
4. Cleanouts.

3.3 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, 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 Section 078413 "Penetration Firestopping" for 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 Section 078413 "Penetration Firestopping."

3.4 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, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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 that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

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. Instead, 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 that of 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 that of 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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:

1. Install 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 sheet insulation of same thickness as that of pipe insulation.
4. 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.

C. 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

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. Instead, 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 that of 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 that of 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.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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:

1. Install 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 polyolefin sheet insulation of same thickness as that of pipe insulation.
4. 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.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet 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.
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 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. 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.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. 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.

D. 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.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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 FIELD QUALITY CONTROL

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

B. Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections.

D. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three

locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

E. All insulation applications will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

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 Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be[**one of**] the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Flexible Elastomeric: 1.5 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch thick.
c. Polyolefin: 1.5 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 3/4 inch thick.

END OF SECTION 220719

SECTION 22 11 16 - DOMESTIC WATER 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. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Coordination Drawings: Plumbing systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from the installers of the items involved:

1. Domestic water piping.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B88, Type L water tube, annealed temper.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint, press-connect, or threaded ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

F. Copper Press-Connect Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide products by Viega LLC; ProPress or comparable products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc., ApolloXpress.
    b. Elkhart Products Corporation.
    c. NIBCO INC.

2. Fittings for NPS 2 and Smaller: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
4. Press Ends: Unpressed fitting identification feature to the fitting wall.
5. Sealing Element: EPDM.

G. Cast Copper Alloy Pipe Flanges with Press-Connect Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Viega LLC; ProPress Copper or comparable products by one of the following:

    a. NIBCO INC.

2. Flanges: ASME B 16.24, Class 150, powder coated steel plate; two-piece design.
3. NPS 2-1/2 thru NPS 4 Fittings: Stainless steel grip ring and EPDM O-ring seal in each end.
4. Housing: Copper or bronze.
5. Press Ends: Unpressed fitting identification feature to the fitting wall.
6. Sealing Element: EPDM.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. 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 B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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

    a. A.Y. McDonald Mfg. Co.
    b. Capitol Manufacturing Company.
    c. Central Plastics Company.
    d. HART Industrial Unions, LLC.
    e. Jomar Valve.
    f. Matco-Norca.
    g. WATTS.
    h. Wilkins.
    i. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint, or press-connect joint, copper alloy and threaded ferrous.

C. Dielectric Flanges:

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

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Matco-Norca.
    d. WATTS.
    e. Wilkins.
    f. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint, threaded, or press-connect, copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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

    a. Elster Perfection Corporation.
    b. Grinnell Mechanical Products.
    c. Matco-Norca.
    d. Precision Plumbing Products.
    e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.

E. 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 for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

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 to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

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

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

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. 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Press-Connect Joints for Copper Tubing: Join copper tube and pressure-connect fittings with tools recommended by fitting manufacturer.

1. Mark proper insertion depth prior to making press connection.

G. 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.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits or nipples.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

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.

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. 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 (DN 65): 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.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code.
4. Equipment (ManaBloc/MiniBloc): 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.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. 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:

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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. 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.
c. 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.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 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 hot-water flow 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.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
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.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures 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 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 of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired 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.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 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 the following:

1. Soft copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings and copper press-connect fittings; and press-connect joints.

E. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be the following:

1. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.

F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B88, Type L wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L copper press-connect fittings; and press-connect joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B88, Type L wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L; copper press-connect fittings; and press-connect joints.

3.12 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 or gate valves for piping NPS 2 and smaller. Use ball or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop or Thermostatic balancing valves. Refer to Drawing Schedule.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Air vents.
14. Trap-seal primer valves.
15. Trap-seal primer systems.
16. Specialty valves.
17. Flexible connectors.
18. Water meters.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.6 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. NSF Compliance as required by authorities having jurisdiction:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, "Drinking Water System Components – Lead Content."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 35XL (Lead-Free) or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 2, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model BFP-8F or comparable product by one of the following:

a. Cash Acme; a division of Reliance Worldwide Corporation.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Laboratory-Faucet Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 730 or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

D. Spill-Resistant Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 460 or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 to NPS 25, as required to match connected piping.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 760 or comparable product by one of the following:

    a. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 to NPS 3/4, as required to match connected piping.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins: Model 375A (Lead-Free) or comparable product by one of the following:

    a. Conbraco Industries, Inc.
    b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1013, CSA B64.4, IAPMO, USC FCCCHR, UL Listed, FMG approved, and AWWA C511.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: NPS 1/2 to NPS 10.
6. Body: Bronze for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger:

        1) Valve Type: Non-rising stem gate valves.
        2) End Connection: Flanged end connections.

    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    d. Strainer Option: Cast iron wye strainer.

C. Double-Check, Backflow-Prevention Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 350A (Lead-Free) or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: NPS 1/2 to NPS 12.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal flow.
8. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
b. Valves NPS 2-1/2 and Larger:

1) Valve Type: Non-rising stem gate valves.
2) End Connection: Flanged end connections.

c. Strainer Option: Epoxy coated wye strainer.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 375ST (Lead-Free) or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 to NPS 1.
5. Body: Stainless steel.
6. End Connections: Threaded.

E. Hose-Connection Backflow Preventers:

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

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.
c. Woodford Manufacturing Company; a division of WCM Industries, Inc.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 70XL (Lead-Free) or comparable product by one of the following:

    a. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: NPS 1/2 to NPS 3.
5. Body: Bronze.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded.

B. Water-Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model ZW204 (Lead-Free) or comparable product by one of the following:

    a. CLA-VAL.
    b. OCV Control Valves.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

    a. Size: NPS 1-1/2 to NPS 10.
    b. Pattern: Globe-valve design.
    c. Trim: Stainless steel.

5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves:

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

    a. Conbraco Industries, Inc.
    b. Bell & Gossett

c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO Inc.
i. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model ZW1017XL (Lead-Free) or comparable product by one of the following:

a. Leonard Valve Company.
b. Powers; a division of Watts Water Technologies, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.

B. Individual-Fixture, Water Tempering Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model ZW3870XLT (Lead-Free) or comparable product by one of the following:

a. Cash Acme; a division of Reliance Worldwide Corporation.
b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.

4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Light Commercial Products; or comparable product by one of the following:

    a. Acorn Engineering Company.
    b. Guy Gray Manufacturing Co., Inc.
    c. IPS Corporation.
    d. LSP Products Group, Inc.
    e. Oatey.
    f. Plastic Oddities.
    g. Symmons Industries, Inc.
    h. Watts; a Watts Water Technologies company.
    i. Whitehall Manufacturing; a div. of Acorn Engineering Company.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 1-1/2 standpipe and P-trap for direct waste connection to drainage piping.

7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

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

   a. Acorn Engineering Company.
   b. IPS Corporation.
   c. LSP Products Group, Inc.
   d. Oatey.
   e. Plastic Oddities.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE STATIONS

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. ARCHON Industries, Inc.
2. Armstrong International, Inc.
3. Cooney Brothers, Inc.
4. DynaFluid Ltd.
5. Leonard Valve Company.
6. Strahman Valves, Inc.
7. T & S Brass.

2.11 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.12 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Light Commercial Products or comparable product by one of the following:

    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Woodford Manufacturing Company; a division of WCM Industries, Inc.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Specification Drainage Products; Z1325 or comparable product by one of the following:

    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Woodford Manufacturing Company; a division of WCM Industries, Inc.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.

5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Vacuum Breaker:

    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.

11. Operating Keys(s): Two with each wall hydrant.

2.13 DRAIN VALVES

A. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.14 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Specification Drainage Products; Z1700 or comparable product by one of the following:

    a. Precision Plumbing Products, Inc.
    b. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.15 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.16 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Z1021 or comparable product by one of the following:

    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Precision Piping Products.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.17 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Z1020XL or comparable product by one of the following:

    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Precision Piping Products
    c. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

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.

6. Vacuum Breaker: ASSE 1001.
7. Size Outlets: NPS 1/2.

2.18 FLEXIBLE 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. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company

B. 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.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

2.19 WATER METERS

A. Displacement-Type Water Meters:

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

a. AALIANT; a Venture Measurement product line.
b. ABB.
c. Badger Meter, Inc.
d. Carlon Meter.
e. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
f. Schlumberger Limited; Water Services.
g. Sensus.

2. Description:

a. Standard: AWWA C700.

b. Pressure Rating: 150-psig working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons or as required by utility company.
e. Case: Bronze.
f. End Connections: Threaded.

B. Turbine-Type Water Meters:

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

a. AALIANT; a Venture Measurement product line.
b. ABB.
c. Badger Meter, Inc.
d. Hays Fluid Controls.
e. Master Meter, Inc.
f. McCrometer, Inc.
g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
h. Schlumberger Limited; Water Services.
i. SeaMetrics Inc.
j. Sensus.

2. Description:

a. Standard: AWWA C701.
b. Pressure Rating: [150-psig working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons, or as required by utility company.
e. Case: Bronze.
f. End Connections for Meters NPS 2 and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water Meters:

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

a. ABB.
b. Badger Meter, Inc.
c. Master Meter, Inc.
d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
e. Schlumberger Limited; Water Services.
f. Sensus.

2. Description:

a. Standard: AWWA C702.
b. Pressure Rating: 150-psig working pressure.

c. Body Design: With integral mainline and bypass meters; totalization meter.
d. Registration: In gallons or as required by utility company.
e. Case: Bronze.
f. Pipe Connections: Flanged.

D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve and pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

I. Install water-hammer arresters in water piping according to PDI-WH 201.

J. Install air vents at high points of water piping.

K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

L. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

M. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Water pressure-reducing valves.
9. Calibrated balancing valves.
10. Primary, thermostatic, water mixing valves.
11. Outlet boxes.
12. Hose stations.
13. Supply-type, trap-seal primer valves.
14. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 22 11 23 - FACILITY NATURAL-GAS 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. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters.
6. Dielectric fittings.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.10 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.11 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. 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.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: [125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

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

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

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

    a. Lee Brass Company.
    b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

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

    a. Flowserve.

b. Homestead Valve; a division of Olson Technologies, Inc.
c. McDonald, A. Y. Mfg. Co.
d. Milliken Valve Company.
e. Mueller Co.; Gas Products Div.
f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

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

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eaton Corporation; Controls Div.
d. Eclipse Combustion, Inc.
e. Honeywell International Inc.
f. Johnson Controls.

2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

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

    a. Actaris.
    b. American Meter Company.
    c. Eclipse Combustion, Inc.
    d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    e. Invensys.
    f. Maxitrol Company.
    g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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

    a. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div.
    c. Harper Wyman Co.
    d. Maxitrol Company.

e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilkins; a Zurn company; Model DUBI or comparable product by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International Ltd.
e. Matco-Norca, Inc.
f. McDonald, A. Y. Mfg. Co.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilkins; a Zurn company; Model DUBI or comparable product by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: ASSE 1079.

b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 125 psig minimum at 180 deg F.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

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

E. Install pressure gage downstream of each service regulator. Pressure gages are specified in Section 220519 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

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

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

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

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

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

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

4. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground**,** on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

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

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel semigloss.
    d. Color: Pipe – Safety Yellow, Accessories - Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG:

A. Aboveground, branch piping NPS 1 and smaller shall be the following:
1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.18 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:

1. PE valves.
2. NPS 2 and Smaller: Bronze plug valves.
3. NPS 2-1/2 and Larger: Cast-iron, lubricated plug valves.

3.19 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 231123

SECTION 221413 - FACILITY STORM DRAINAGE 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. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which drainage piping will be attached or suspended from.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

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

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. NewAge Casting.
4. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Class: ASTM A74, Service class.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

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

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. NewAge Casting.
4. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Dallas Specialty & Mfg. Co.
d. Fernco Inc.
e. Ideal Clamp Products, Inc.
f. Matco-Norca.
g. MIFAB, Inc.

h. Mission Rubber Company, LLC; a division of MCP Industries.
i. NewAge Casting.
j. Tyler Pipe; a subsidiary of McWane Inc.

2. Couplings shall bear CISPI collective trademark.
3. Standards: ASTM C1277 and CISPI 310.
4. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Clamp-All Corp.
d. Dallas Specialty & Mfg. Co.
e. Ideal Clamp Products, Inc.
f. MIFAB, Inc.
g. Mission Rubber Company, LLC; a division of MCP Industries.
h. NewAge Casting.
i. Tyler Pipe; a subsidiary of McWane Inc.

2. Standard: ASTM C1540.
3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from 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 at indicated slopes.

F. Install piping free of sags and bends.

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

H. Install piping to allow application of insulation.

I. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

K. Install piping at the following minimum slopes unless otherwise indicated:

1. Building Storm 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.

L. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

M. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping.

    a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install 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.

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.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

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.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping in accordance with 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.

a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

a. Test storm drainage piping**,** except outside leaders**,** on completion of roughing-in.
b. 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 until completion of inspection, water level must not drop. Inspect joints for leaks.

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 required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

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.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 4 to NPS 10 shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping NPS 4 to NPS 10 shall be the following:

1. Push-Fit, 316L Stainless steel pipe and fittings; gaskets; and gasketed joints.
2. Service class, cast-iron soil pipe and fittings; lead and oakum joints.

END OF SECTION 221413

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract 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.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.
11. Specific requirements for conducting work required by this contract.

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. PE: Polyethylene plastic.
3. 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.

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. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

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.

C. 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.

1.6 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.

1.7 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 MANUFACTURERS

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.

2.2 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.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. 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 (3.2-mm) 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.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. 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.

2.4 TRANSITION FITTINGS

A. 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.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

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 (82 deg C).

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.
h. Or approved equivalent.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Or approved equivalent.

E. Dielectric-Flange Kits: 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.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equivalent.

2. 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: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or approved equivalent.

G. 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 (107 deg C).

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.
e. Or approved equivalent.

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. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equivalent.

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: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 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. 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.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

A. In addition to general instructions contained in the General or Project Requirements, equipment and its installation shall conform to the following applicable codes, standards and regulations, latest editions:

1. American Society for Testing and Materials (ASTM).
2. American Society of Mechanical Engineers (ASME).
3. American National Standard Institute (ANSI).
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
5. American Refrigeration Institute (ARI).
6. American Welding Society Code (AWSC).
7. Code for Pressure Piping (ANSI B 31.1).
8. International Building Code.
9. International Mechanical Code.
10. National Standard Plumbing Code and International Plumbing Code.
11. International Energy Conservation Code.
12. National Electrical Code (NEC).
13. National Fire Protection Association (NFPA).
14. National and Local Building, Plumbing and Mechanical Codes.
15. Occupational Safety & Health Act (OSHA).
16. Sheet Metal & Air Conditioning Contractors National Association (SMACNA).
17. Underwriters' Laboratories, Inc. (UL).
18. Air Moving and Conditioning Association, Inc. (AMCA).
19. Associated Air Balance Council (AABC).
20. National Environmental Balancing Bureau (NEBB).
21. Building Officials and Code Administrators (BOCA).
22. Hydraulic Institute (HI).
23. Manufacturer's Standardization Society (MSS).
24. Cooling Tower Institute (CTI).
25. Environmental Protection Agencies - Federal, State and Local (EPA).

3.2 STANDARD OF QUALITY

A. The specifications establish the standards of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number.

B. Where one product only is specifically identified by name or manufacturer's model number, the Contractor shall base his bid on the use of the named product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named. The Contractor

bears full responsibility for the cost of any changes incurred by using equipment other than a listed manufacturer.

C. Where no manufacturer is specified, the Contractor shall meet the performance requirements of the equipment schedule and respective specification section.

D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide data sufficient to inform the Engineer of the basis of equality of the substitution to that of the equipment and/or materials specified.

E. When equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, ductwork and any engineering review or redesign, etc. Such additional cost shall be identified at the time such substitutions are proposed.

F. Contractor is responsible for the installation of all systems and equipment in strict accordance with the equipment or systems manufacturer's recommendations and/or requirements. In the event that the contract documents are not in accordance with the manufacturer's recommendations, the Contractor must notify the Engineer of the discrepancy, prior to proceeding with the installation of the equipment.

3.3 PROTECTION OF WORK

A. Contractor is responsible for the protection of his materials, equipment and completed work as defined in the General or Project Requirements and as supplemented herein.

3.4 MOVING OF EQUIPMENT

A. Verify that mechanical equipment will pass through all restricting openings, and when equipment or sections of equipment are larger than these openings, install this equipment prior to construction of enclosing walls, floors or roofs.

B. Use planking or cribbing as required to protect adjoining existing construction or new construction from damage.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 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 where possible. Diagonal runs are prohibited unless specifically indicated otherwise or as indicated on the coordination drawings.

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. 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, 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 "Joint Sealants" 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 for all pipe sizes.

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.

3.6 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.

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. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

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

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
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.

3.7 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.
2. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.8 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.

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

3.9 CUTTING, PATCHING AND PAINTING

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

B. Provide all openings through walls, floors and ceilings, etc. required for the installation of work defined on the Contract Drawings and Specifications.

C. Cutting and patching shall be performed only by tradesmen familiar with the construction involved.

3.10 FLASHING

A. Where ducts, pipes or other items pass through any roof, wall or other exterior component, provide flashing as detailed on Contract Drawings. At a minimum, for roofing penetrations, contractor shall finalize all penetrations in accordance with roofing system manufacturer's requirements (whether warranty is valid or invalid). If roof warranty is intact, contractor shall notify roofing manufacturer prior to commencing work to insure all warranties will be maintained post work completion.

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Structural Steel Framing" 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. Provide all miscellaneous steel supports and anchors required for equipment and materials installed under this Specification. Manual of Construction by American Institute of Steel Construction latest edition shall be followed in design and construction except paragraph 4.2.1 and 4.2.2, Section 4 of Division 5, page 5-177 will not apply. Structural steel members shall conform to ASTM A36, and shall have a shop applied coat of rust inhibitive paint.

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

D. Bolts, nuts and washer shall be high tensile type minimum 3/4" diameter conforming to ASTM A325.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.13 GROUTING

A. Mix and install grout for HVAC 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 230500

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 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.

1.2 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.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet 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 efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. 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.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. 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.

J. 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.
5. Bearings: Insulated to eliminate shaft voltages and bearing currents. Must provide a high impedance to high frequency signals to be effective against common mode voltage induced bearing currents.
6. Shaft Grounding: Means to ground shaft to mitigate stay currents.

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.

END OF SECTION 230513

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flexible, ball-joint, packed expansion joints.
2. Slip-joint packed expansion joints.
3. Expansion-compensator packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Metal-bellows packless expansion joints.
6. Rubber packless expansion joints.
7. Pipe loops and swing connections.
8. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

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

B. Welding certificates.

C. Product Certificates: For each type of expansion joint, from manufacturer.

D. Maintenance Data: For expansion joints to include in maintenance manuals.

1.5 QUALITY ASSURANCE

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints:

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

   a. Adsco Manufacturing LLC.
   b. Flexicraft Industries.
   c. Flex Pression Ltd.
   d. Flex-Weld, Inc.
   e. Hyspan Precision Products, Inc.
   f. Metraflex, Inc.
   g. Senior Flexonics Pathway.
   h. Unaflex.
   i. Unisource Manufacturing, Inc.
   j. Or approved equal.

2. Minimum Pressure Rating: 150 psig unless otherwise indicated.
3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.

   a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
   b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.

4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

   a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
   b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Weld.

B. Rubber, Expansion-Compensator Packless Expansion Joints:

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

   a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
   b. Flex-Hose Co., Inc.
   c. Flexicraft Industries.
   d. General Rubber Corporation.
   e. Mason Industries, Inc.; Mercer Rubber Co.
   f. Proco Products, Inc.
   g. Tozen Corporation.
   h. Unaflex.
   i. Unisource Manufacturing, Inc.
   j. Or approved equal.

2. Material: Twin reinforced-rubber spheres with external restraining cables.

3. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints:

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

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex Pression Ltd.
   d. Metraflex, Inc.
   e. Unisource Manufacturing, Inc.
   f. Or approved equal.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
   b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or weld end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged or weld end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

9. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with weld end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

D. Metal-Bellows Packless Expansion Joints:

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

    a. Adsco Manufacturing LLC.
    b. American BOA, Inc.
    c. Badger Industries, Inc.
    d. Expansion Joint Systems, Inc.
    e. Flex-Hose Co., Inc.
    f. Flexicraft Industries.
    g. Flex Pression Ltd.
    h. Flex-Weld, Inc.
    i. Flo Fab inc.
    j. Hyspan Precision Products, Inc.
    k. Metraflex, Inc.
    l. Proco Products, Inc.
    m. Senior Flexonics Pathway.
    n. Tozen Corporation.
    o. Unaflex.
    p. Unisource Manufacturing, Inc.
    q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
    r. U.S. Bellows, Inc.
    s. WahlcoMetroflex.
    t. Or approved equal.

2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
5. Configuration: Single joint with base class(es) unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.
    c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

    a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged or Weld.

E. Rubber Packless Expansion Joints:

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

    a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
    b. Flex-Hose Co., Inc.
    c. Flexicraft Industries.
    d. Flex-Weld, Inc.
    e. Garlock Sealing Technologies.
    f. General Rubber Corporation.
    g. Mason Industries, Inc.; Mercer Rubber Co.
    h. Metraflex, Inc.
    i. Proco Products, Inc.
    j. Red Valve Company, Inc.
    k. Tozen Corporation.
    l. Unaflex.
    m. Unisource Manufacturing, Inc.
    n. Or approved equal.

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalies, or Chemicals: BR.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N.
11. Material for Water: EPDM.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

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

    a. Adsco Manufacturing LLC.
    b. Advanced Thermal Systems, Inc.
    c. Flex-Hose Co., Inc.
    d. Flexicraft Industries.

e. Flex-Weld, Inc.
f. Hyspan Precision Products, Inc.
g. Metraflex, Inc.
h. Senior Flexonics Pathway.
i. Unisource Manufacturing, Inc.
j. U.S. Bellows, Inc.
k. Or approved equal.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

D. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect mains, risers and branch connections as indicated on the contract drawings.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

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

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

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

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

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.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079220 "Interior Joint Sealants."

E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6 Cast-iron wall sleeves.
    b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6 Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6 Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230519

METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following meters and gauges for mechanical systems:

1. Thermometers.
2. Gauges.
3. Test plugs.
4. Flowmeters.
5. Flow Totalizer for Make-up Water.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. Condenser Water Loop requirements shall apply to Water-Source Heat Pump piping.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers, gauges, flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gauge, flowmeter and thermal-energy meter, signed by product manufacturer.

D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

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 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
5. Or approved equivalent.

B. Case: Die-cast aluminum, 7 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

7. Or approved equivalent.

B. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal or plastic.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
11. Winters Instruments.
12. Or approved equivalent.

B. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with for panel mounting.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal.

I. Connector: Bottom union type.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Ernst Gage Co.
3. Eugene Ernst Products Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equivalent.

B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

C. Case: Liquid-filled type, stainless steel with 5-inch diameter.

D. Element: Bimetal coil.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Stainless steel.

I. Connector: Adjustable angle type.

J. Stem: Metal, for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.6 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equivalent.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.7 PRESSURE GAUGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.

15. Winters Instruments.
16. Or approved equivalent.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic.
8. Ring: Metal or plastic.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Direct or Remote-Mounting, Dial-Type Pressure Gauges: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic.
8. Ring: Metal or plastic.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gauge Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.8 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.

5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.
8. Or approved equivalent.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gauge and adaptor, two thermometer(s), and carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gauge: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- Insert other diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each hydronic zone or equipment as noted on plans.

B. Install liquid-filled-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
4. Condenser Water (Heat Pump): 0 to 160 deg F, with 2-degree scale divisions.
5. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
6. Glycol: 0 to 160 deg F, with 2-degree scale divisions.
7. Steam and Condensate: 30 to 300 deg F, with 5-degree scale divisions.
8. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers.

C. Install dry-case-type pressure gauges at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

E. Install remote-mounting pressure gauges on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gauge for fluids (except steam).

G. Install needle-valve and syphon fitting in piping for each pressure gauge for steam.

H. Install test plugs in tees in piping.

I. Install flow indicators, in accessible positions for easy viewing, in piping systems.

J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

K. Install flowmeter elements in accessible positions in piping systems.

L. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings for attachment to portable indicators in accessible locations.

O. Install flowmeters at discharge of hydronic system pumps or as shown on dwgs.

P. Assemble components and install thermal-energy meters.

Q. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 230519

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 SUBMITTALS

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

B. Shop Drawings: Submit product data, fabrication and installation details and include calculations for the following:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Equipment supports.

C. Welding certificates.

1.3 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

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

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

D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

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

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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

D. 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.

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

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal 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.

H. 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.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by 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 to NPS 6: 12 inches long and 0.06 inch thick.
    c. NPS 8 to NPS 10: 18 inches long and 0.06 inch thick.
    d. NPS 12 to NPS 30: 24 inches long and 0.07 inch thick up to NPS 18 and .10 inch thick from NPS 20 to NPS 30.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

3.3 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

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. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

B. Touchup: 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.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. 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.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

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

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

END OF SECTION 230529

SECTION 230548

VIBRATION ISOLATION AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section specifies required vibration control for all equipment, where applicable, with the wind load requirements for all equipment in outdoor locations. Additionally, included are provisions for flood control as stated herein. When projects are located in a geographically active wind or flood location, Section 1.4, General Design and Performance Requirements, will elaborate on those requirements and include specifics pertaining to a facility's "continued operation." Para. 1.2, Section D is a partial list of components covered herein. This specification is part of the general conditions for the HVAC contract.

1.2 SUMMARY

A. This section includes the following:

1. All equipment, piping, ductwork and conduit as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.

2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2018. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.

3. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.

4. Wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.

5. It is the intent of the wind load portion of this specification to keep all mechanical building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.

6. All such systems must be installed in strict accordance with wind codes, component manufacturer's and building construction standards.

7. This specification is considered to be minimum requirements for wind, flood and vibration control considerations.

8. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.

B. The work in this section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork, bus duct, cable tray conduit and equipment, all referred to as components.

2. Component isolation bases.

3. Wind restraints for isolated components.

4. Wind restraints for non-isolated components.

5. Certification of wind restraint designs.

6. Installation supervision.

7. Design of attachment of housekeeping pads.

8. All components requiring IBC compliance and certification.

9. All inspection and test procedures for components requiring IBC compliance.

C. All mechanical equipment, pipe and ductwork, within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.

D. Components referred to below are typical. (Components not listed are still included in this specification.) All systems that are part of the building in any way are referred to as components, including:

- AC Units
- Adapter Curb
- Air Handling Units
- Air Separators
- Boilers
- Cabinet Unit Heaters
- Chillers
- Compressor
- Computer Room Units
- Condensing Units
- Cooling Towers
- Curbs
- Dry Coolers
- Ductwork
- Equipment Supports
- Fans (all types)
- Fan Coil Units
- Gas Detection Systems
- Heat Exchangers
- Humidifiers
- Pipe
- Pumps (all types)
- Risers
- Rooftop Units
- Supports
- Tanks (all types)
- Unit Heaters
- Unit Ventilators
- Variable Frequency Drives
- VAV Boxes
- Vibration Isolators
- Water Heaters

1.3 DEFINITIONS (BUILDING AND COMPONENTS, ALL CODES)

A. ESSENTIAL FACILITIES, (Occupancy Category, IBC-2018)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

B. General

1. Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.

2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services, when such agency has been approved.

3. Attachment: See Positive Attachment below.

4. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2018), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609.3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.

5. Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any direction.

6. Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component manufacturer.)

7. Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.

8. Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5.

9. Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.

10. Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.

11. Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.

12. Equipment: Systems associated with ducts, pipes and conduits also called components.

13. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:

    a. The overflow of inland or tidal waters.
    b. The unusual and rapid accumulation of runoff of surface waters from any source.

14. Flood Hazard Area: The greater of the following of two areas:

    a. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
    b. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

15. Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.

16. Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

17. Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.

18. Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

19. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.

20. Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.

21. Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1703.5 and "Label" and "Manufacturer's Designation" and "Mark").

22. Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and

identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 1703.5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").

23. Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.

24. Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.

25. Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.

26. Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label" and "Manufacturer's Designation").

27. Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate," "Label" and "Mark".)

28. Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.

29. Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.

30. Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2 (IBC-2018).

31. Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special documents and referenced standards (see Section 1704, IBC-2018).

32. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

33. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

34. Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.

35. Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. General Design Requirements.

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:

   a. NONE.

2. WIND CONSIDERATIONS: This project has wind design requirements as follows:

   a. For new equipment and existing equipment receiving new roof curbs or equipment supports, provide positive attachments and restraints capable of withstanding the following parameters:

      1) Ultimate Wind Speed: 125 mph.
      2) Risk Category: III.
      3) Wind Exposure Category: D.

3. FLOOD CONSIDERATIONS: This project has design requirements in accordance with FEMA and/or FIRM as follows:

   a. NONE.

B. General Design Performance Requirements

1. Design Wind Loads:

   a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
      1) If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
      2) If component is support mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base type B-5 if isolated, Base type B-6 if non-isolated.
      3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.

   b. Loads and calculations shall be based on IBC-2018, figure 1609 and related sections in ASCE 7-05.
   c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.

d. Equivalent basic wind speed shall be based on IBC-2018, Table 1609.3.1.
e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

1.5 SUBMITTALS

A. Refer to Part 1, General.

B. Product Data: The manufacturer of vibration isolation, seismic, wind and flood restraints shall provide submittals for products as follows:

1. Descriptive Data:

a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive drawings.

2. Shop Drawings:

a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
b. Provide all details of suspension and support for ceiling hung equipment.
c. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third party certification.
d. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer of vibration isolation and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:

1. Determine vibration isolation and restraint sizes and locations.

2. Provide vibration isolation and restraints as scheduled or specified.

3. Provide calculations and materials, if required, for restraint of non-isolated equipment.

4. Provide installation instructions in writing, drawings and trained field supervision, where necessary, to insure proper installation and performance.

5. Certify correctness of installation upon completion, in writing.

6. All provisions of Section 1.4, General Design and Performance Requirements.

B. All manufacturers of vibration control, wind or flood restraining systems must provide a Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the restraint provider.

C. All manufacturers of any type of equipment including OEM are responsible for Section 1.4.

D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met.

E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable.

1.7 RELATED WORK

A. Housekeeping pad structural design, including its attachment to building structure, shall be by the structural engineer of record or as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.

B. The project's structural engineer shall design all roof and interior steel to support and make connections to all components, including roof-mounted equipment specified in other sections. Design shall comply with IBC requirements including load path to structure.

C. Roof steel supporting roof-mounted equipment shall be designed for all wind forces including, but not limited to, tension, compression and moment loads.

D. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.

1.8 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

1. All City, State and Local Codes (Code)

    a. American Society For Testing and Materials (ASTM) (Standard)
    b. International Conference of Building Officials (ICBO) (Standard)
    c. International Building Code (Code)
    d. ASHRAE (Standard reference, to be used for design purposes only, not code).

e. VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code).

B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

C. International Fire Code

D. Use IBC-2018 as reference code standard unless otherwise designated.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. The basis of this specification is The VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics. Products from other nationally recognized manufacturers are acceptable provided their systems strictly comply with these specifications and have the approval of the specifying engineer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). See Form VL-1 listing other manufacturers to be considered for use on this project.

2.2 VIBRATION ISOLATION TYPES

A. Type A: Spring Isolator – Free Standing,
A*

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or ¼" elastomeric acoustical friction pad between the bottom of isolator and the support.

2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.

3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.

4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.

B. Type B: Wind Restrained Spring Isolator
MS, MSS, AEQM, ASCM, AMSR

1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or

welded in position there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.

C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)
HRSA

1. Hangers shall consist of rigid steel frames containing minimum 1 ¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.

2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short-circuiting the spring.

3. Submittals shall include a hanger drawing showing the 30° capability.

4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

D. Type D: Elastomer Double Deflection Hanger Isolator
HR

1. Molded (minimum 1 ¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35."

2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

E. Type E: Combination Spring/Elastomer Hanger Isolator
HRS

1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.

2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

3. 30° angularity feature is not required.

F. Type F: Wind Restrained Elastomer Floor Isolator
RSM, MB, RUD

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or DuruleneTM specifications.

G. Type G: Pad Type Elastomer Isolator (Standard)
Maxiflex

1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.

2. Load distribution plates shall be used as required.

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

H. Type H: Pad Type Elastomer Isolator (High Density)
Fabri-Flex, NDB, NRC

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.

2. Load distribution plate shall be used as required.

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

I. Type I: Thrust Restraints
RSHTR, TRK

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to ¼" due to thrust forces. Contractor shall supply hardware.

2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

J. Type J: Pipe Anchors
MDPA, AG

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.

2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.

3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

K. Type K: Pipe Guides
PG/AG/SWP/SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum ½" thickness of 60 durometer elastomer.

2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.

3. Guides shall be capable of ± 1 5/8" motion, or to meet location requirements.

L. Type L: Isolated Pipe Hanger System
CIH, CIR, TIH, PIH

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.

2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.

3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.

4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.

5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

2.3 WIND RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained
MS, MSS, AEQM, ASCM, AMRS

1. Refer to vibration isolation Type B.

B. Type II: Wind Restrained Elastomer Floor Isolator
MB, RUD

1. Refer to vibration isolation Type F.

C. Type III: All-Directional Wind Snubber
SR, ER

1. All-directional snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of ¼" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

D. Type IV: Floor or Roof Anchorage
Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

2.4 EQUIPMENT BASES

A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

B. Base Types

1. Type B-1: Integral Structural Steel Base
WFB, SFB, WSB

a. Rectangular bases are preferred for all equipment.
b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."

2. Type B-2: Concrete Inertia Base
MPF, WPF, CPF

a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6."
d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
e. Forms shall include a minimum concrete reinforcing consisting of 3/8" bars welded in place a maximum of 16" on centers running both ways in a layer 1 to 1½" above the bottom.
f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.

3. Type B-3: Wind Load Isolation Curb

P6200, P6300

a. Option: Sound Package 1 & 2 VMC/AB-RPFMA/SRPFMA
   1) Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural wind restrained spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind load forces. The lower frame must accept point support for both wind load attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, paragraph 7, Design Wind Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.
   2) All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or cups.
   3) Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
   4) The curb's waterproofing shall be designed to meet all NRCA requirements.
   5) All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
   6) Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood nailer.

4. Type B-4: Wind Load Non-Isolated Curbs
   P6000

   a. Option: Sound Package VMC-RPFMA/SRPFMA System

      1) Wind load curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
      2) System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind loads.

5. Type B-5: Isolated Equipment Supports
   R7200/R7300

   a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B-3.
   b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind loads.

6. Type B-6: Non-Isolated Equipment Supports
   R7000

a. This shall have the same provisions as Type B-5 without the spring isolation.

7. Type B-8 AHU / AC unit Structural Base Frames

a. Where roof mounted Air Conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind restrained isolation system.

b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.

2.5 FLEXIBLE CONNECTORS

A. Type FC-2: Flexible Stainless Steel Hose
SS-FP, SS-FW, SS-PM, SS-WE

1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples.

B. Type BC-2 connector shall be braided bronze for Freon connections.

1. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1 ½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 ½ x 18
6 x 20	16 x 32	1 ¼ x 12	8 x 22

2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All areas that will receive components requiring vibration control or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.

B. Examine all "rough ins" including anchors and reinforcing prior to placement.

3.2 APPLICATIONS

A. All vibration isolators and wind restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

B. Installation of vibration isolators and wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein.

D. The contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.

G. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.

H. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraints shall be those described in the specification when horizontal motion exceeds 3/8."

3.3 EQUIPMENT INSTALLATION

A. Equipment shall be isolated and/or restrained as per Tables A-E at the end of this section.

B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck. Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.

C. Additional Requirements:

1. The minimum operating clearance under all isolated components bases shall be 2."

2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.

3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.

4. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

3.4 PIPING AND DUCTWORK ISOLATION

A. Vibration Isolation of Piping:

1. HVAC Water Piping: All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3," 1 3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2½" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.

2. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article 1, above.

3. Gas lines shall not be isolated.

4. Fire protection lines shall not be isolated.

PART 4 - SELECTION GUIDE FOR VIBRATION ISOLATION AND WIND RESTRAINTS

TABLE "A" HVAC EQUIPMENT										
	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
EQUIPMENT (See Notes)	Size/Type	Mtg	Isol	Nom Defl*	Base	Restr	Isol	Nom Defl*	Base	Restr
Air Handling Units Indoor		Floor	A	0.75	---		A	1.5	---	
		Ceiling	---	---	---	---	E	0.75	---	
Dry Coolers Outdoor Condensing Units/Condensers		Roof	---	---	---	IV	B	1.0 Minimum	B-5	IV
Axial Fans (Inline Type)		Floor	A	0.75	---		A	See Guide	---	
		Ceiling	---	---	---	---	E	See Guide	---	
Base Mounted Pumps	To 15 HP	Floor	A	0.75	B-2		A	0.75	B-2	
	>15 HP	Floor	A	0.75	B-2		A	1.50	B-2	
Boilers		Floor	G	0.10	---	IV	B	0.75	---	
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	A	0.75	---	
	>1 HP	Floor	A	0.75	---	=	A	See Guide	---	
		Ceiling	---	---	---	---	A	See Guide	---	
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	A	0.75	B-1		A	See Guide	B-1	
	Class 2 & 3	Floor	A	0.75	B-2		A	See Guide	B-2	
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	A	0.75	---		A	See Guide	See Note 4	
	Class 2 & 3	Ceiling	---	---	---	---	A	See Guide	B-2	
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	---
Fan Coil Units		Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	E	0.75	---	
Rooftop AHU/AC *(curb mounted)*	< 20 Ton	Roof	---	---	---	---	---	---	---	---
	> 20 Ton	Roof	---	---	---	IV	B	2.50	B-3 See Notes 5,6	---
Rooftop AHU/AC *(dunnage mounted)*	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-8	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-8	---

*See Minimum Deflection Guide for Equipment with Low RPM
*Where Component cannot be point supported, Base Type B-1 shall be used.

Minimum Deflection Guide for Equipment with Low RPM:

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5”
401 thru 600	2.5”
601 thru 900	1.5”
Greater than 900	0.75”

General Notes for Table:

1. Abbreviations:
   (1) Mtg = Mounting
   (2) ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
   (3) Defl = Minimum Deflection of Vibration Isolator
   (4) Base = Base Type per Section 2.4, Equipment Bases
   (5) Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types

2. All deflections indicated are in inches. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.

3. For roof applications, use base Type B-5.

4. Units may not be capable of point support. Refer to separate air handling unit specification section. If that section does not provide base and external isolation is required, provide Type B-1 base by this section for entire unit.

5. Static deflection shall be determined based on the deflection guide for Table “A.”

6. Deflections indicated are minimums at actual load and shall be selected for manufacturer’s nominal 5,” 4,” 3,” 2” and 1” deflection spring series; RPM is defined as the lowest operating speed of the equipment.

7. Single stroke compressors may require inertia bases with thicknesses greater than 14” maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8.”

8. Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5.”

9. Indoor utility sets with wheel diameters less than 24” need not have deflections greater than .75.”

10. Curb-mounted fans with curb area less than 9 square feet are excluded.

11. For equipment with multiple motors, Horsepower classification applies to largest single motor.

END OF SECTION 230548

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.

1.2 ACTION 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.

1.3 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: Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 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.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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.
2. Letter Color: White.
3. Background Color: Black.
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.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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.

B. Letter Color: White. Unless otherwise directed by owner.

C. Background Color: Red. Unless otherwise directed by owner

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. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. 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. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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 DUCT LABELS

A. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Plastic Labels: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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.

2.5 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; or S-hook.

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.

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. 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.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Chilled-Water, Glycol, Dual Temperature or Condenser (Heat Pump) Piping:

   a. Background Color: Green.
   b. Letter Color: White.

2. Hot-Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Natural Gas:
   a. Background Color: Yellow.
   b. Letter Color: Black.

4. Dual Temperature (Hot and Chilled Water) Piping:

   a. Background Color: Green.
   b. Letter Color: White.

5. Refrigerant Liquid and Suction Piping:

   a. Background Color: Green.
   b. Letter Color: White.

6. Refrigerant Relief Piping:

   a. Background Color: Black.
   b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Supply, Intake or Outdoor Air Ducts:

   a. Background Color: Green.
   b. Letter Color: White.

2. Return or ERU Return/Exhaust Air Ducts:

   a. Background Color: Green.
   b. Letter Color: White.

3. Exhaust Air Ducts:

a. Background Color: Yellow.
b. Letter Color: Black.

4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. 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 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 HVAC terminal devices 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:

a. Chilled Water, Glycol, Dual Temperature or Condenser (Heat Pump): 1-1/2 inches, round.
b. Refrigerant: 1-1/2 inches, square.
c. Hot Water: 1-1/2 inches, round.
d. Dual Temperature: 1-1/2 inches, round.
e. Gas: 1-1/2 inches, square.

2. Valve-Tag Color:

a. Chilled Water, Glycol, Dual Temperature or Condenser (Heat Pump): Natural.
b. Refrigerant: Natural.
c. Hot Water: Natural.
d. Gas: Natural.

3. Letter Color:

a. Chilled Water, Glycol, Dual Temperature or Condenser (Heat Pump): Black.
b. Refrigerant: Black.
c. Dual Temperature: Black.
d. Hot Water: Black.
e. Gas: Black.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Testing, Adjusting and Balancing (TAB) to produce design objectives for the following:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.

3. Balancing and Verification that automatic control devices are functioning properly for all equipment covered by this Section including their interlock/monitoring with the fire alarm system.

4. Reporting results of activities and procedures specified in this Section.

1.2 REFERENCE SECTIONS

A. Section 230900 HVAC Instrumentation and Controls.

B. Mechanical Contract Drawings including equipment schedules, diagrams and details.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) and metric (SI) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the supply- and exhaust-air dampers through the supply and exhaust-fan discharge.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of exhaust fan components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 TESTING, ADJUSTING AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust and balance HVAC equipment and systems affected by the scope of work as indicated on Drawings.
   1. All new HVAC equipment as indicated on drawings.

B. Refer to reporting requirements in Sections below for further clarifications for data to be collected and procedures to be executed.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

   1. Measure total airflow.

      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

   2. Measure fan static pressures as follows to determine actual static pressure:

      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

   3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   4. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for adjustment of fans, belts, and pulley sizes to achieve indicated unit performance.
   5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-exhaust, full-supply, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

   1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure Dependent, Variable Air Volume Systems: Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
d. Adjust controls so that terminal is calling for minimum airflow.
e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, speed, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.

f. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank pressure setting.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake

horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated pre-settings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for constant-volume hydronic systems.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.

5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.14 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.
5. Dual Temperature Flow Rate: Plus or minus 10 percent.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Engineer's name and address.

6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports <DOAS, VRF>: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.

j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Fan Test Reports <EF, SF>: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated air flow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual air flow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

H. Pump Test Reports <P>: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm.
    g. Water pressure differential in feet of head or psig.
    h. Required net positive suction head in feet of head or psig.
    i. Pump rpm.
    j. Impeller diameter in inches.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btuh.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btuh.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

J. Apparatus-Coil Test Reports <Integral (Unit) or Duct-Mounted Coils as they apply to all equipment>:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values); As Applicable to Specific Coil Type:

    a. Air flow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig.
    n. Refrigerant suction temperature in deg F.
    o. Inlet steam pressure in psig.

K. System-Coil Reports <UV, CUH, UH>: For water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values); Provide for Heating and Cooling Modes of Operation:

    a. Air flow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.

L. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Test apparatus used.
    d. Area served.
    e. Air-terminal-device make.
    f. Air-terminal-device number from system diagram.
    g. Air-terminal-device type and model number.
    h. Air-terminal-device size.

i. Air-terminal-device effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
f. Refrigerant weight in lb.
g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):

a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.
e. Condenser entering-water temperature in deg F.
f. Condenser leaving-water temperature in deg F.
g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Unloader set points.
m. Low-pressure-cutout set point in psig.
n. High-pressure-cutout set point in psig.
o. Suction pressure in psig.
p. Suction temperature in deg F.
q. Condenser refrigerant pressure in psig.
r. Condenser refrigerant temperature in deg F.
s. Oil pressure in psig.
t. Oil temperature in deg F.
u. Voltage at each connection.
v. Amperage for each phase.
w. Kilowatt input.

x. Crankcase heater kilowatt.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in cfm.
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

N.

O. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing efforts are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner, Engineer and/or Commissioning Agent.

2. TAB firm test and balance representative shall conduct the inspection in the presence of the Owner, Engineer and/or Commissioning Agent.

3. The Engineer or Commissioning Agent shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.18 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

1.2 SUBMITTALS

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

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type.

C. Field quality-control inspection reports.

1.3 QUALITY ASSURANCE

A. 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, 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.

B. 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.

C. Insulation products shall carry ISO 9000/9001/9002 certification or guaranteed to meet the ISO standards.

1.4 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.

1.5 DEFINITIONS

A. Exposed: Ductwork or Piping located in mechanical equipment rooms and in indoor areas which will be visible without removing ceilings or opening access panels.

B. Concealed: Indoor ductwork or piping which is not exposed.

C. Outdoor: Ductwork or piping which is exposed to the weather.

D. Underground: Ductwork or piping which is buried; whereas ductwork or piping located in a trench below grade is considered concealed.

1.6 REFERENCE STANDARDS

A. Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section.

B. Comply with all applicable national, state and local codes and refer to specification 230500 Common Work Results for HVAC for additional reference standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about 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. Flexible Elastomeric: Nonhalogen, flexible elastomeric thermal insulation. Comply with ASTM C 534, Type I for tubular materials, Grade 3 and Type II for sheet materials, Grade 3.

1. Available Products:

a. Armacell LLC; NH Armaflex.
b. Aeroflex USA Inc.; Aerocel.
c. K-Flex USA; K-Flex ECO.
d. Or approved equivalent.

G. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Available Products:

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.
f. Or approved equivalent.

H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Available Products:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.
c. Knauf Insulation
d. Or approved equivalent.

I. Mineral-Fiber Board 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 with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Available Products:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.
g. Or approved equivalent.

J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Available Products:

a. Johns Manville; 1000 Series Spin-Glas.
b. Owens Corning; High Temperature Industrial Board Insulations.
c. Rock Wool Manufacturing Company; Delta Board.
d. Roxul Inc.; Roxul RW.
e. Thermafiber; Thermafiber Industrial Felt.
f. Or approved equivalent.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Available Products:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. Owens Corning; Fiberglas Pipe Insulation.
e. Or approved equivalent.

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 Part 2 "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 Part 2 "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Available Products:

a. Knauf Insulation; Permawick Pipe Insulation.
b. Owens Corning; VaporWick Pipe Insulation.
c. Johns Manville.
d. Or approved equivalent.

M. 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 Part 2 "Factory-Applied Jackets" Article.

1. Available Products:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.
f. Or approved equivalent.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Description: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.

1. Available Products:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.
g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.
h. Or approved equivalent.

2.4 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Available Products:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.
d. Or approved equivalent.

2.5 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Available Products:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. Or approved equivalent.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Available Products:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
f. Or approved equivalent.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Available Products:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
f. Or approved equivalent.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Available Products:

    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Red Devil, Inc.; Celulon Ultra Clear.
    e. Speedline Corporation; Speedline Vinyl Adhesive.
    f. Or approved equivalent.

2.6 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. Available Products:

    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.
    g. Or approved equivalent.

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.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Available Products:

    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.
    g. Or approved equivalent.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Available Joint Sealants for Cellular-Glass Products:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.
g. Or approved equivalent.

2. Available Joint Sealants for Polystyrene Products:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
f. Or approved equivalent.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Available Products:

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.
f. Or approved equivalent.

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, and PVC Jacket Flashing Sealants:

1. Available Products:

a. Childers Products, Division of ITW; CP-76.
b. Mon-Eco Industries, Inc.
c. Vimasco Corporation.

d. Or approved equivalent.

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.

2.8 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.

2.9 FIELD-APPLIED JACKETS

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; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Available Products:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or approved equivalent.

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.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Available Products:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.
d. Or approved equivalent.

2. Factory cut and rolled to size.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:

a. Same material, finish, and thickness as jacket.
b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
c. Tee covers.
d. Flange and union covers.
e. End caps.
f. Beveled collars.
g. Valve covers.
h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Available Products:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard; Insulrap No Torch 125.
c. Or approved equivalent.

F. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Available Products:

a. Polyguard; Alumaguard 60.
b. Or approved equivalent.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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 and UL listed.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. 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:

1. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

2. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

C. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened 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:

1. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
2. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

D. Self-Sticking-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:

1. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
2. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
3. Adhesive-backed base with a peel-off protective cover.

E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

F. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

G. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

H. Wire: 0.062-inch soft-annealed, stainless steel.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. 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.

PART 3 - EXECUTION

3.1 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.

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 COMMON 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 with tightly butted joints free of voids and gaps. Vapor barriers shall be continuous. Before installing jacket material, install vapor-barrier system.

C. 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.

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. Hangers and Anchors: 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. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. 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.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. 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.

Q. 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.
4. Manholes.
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, 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 Below-Grade 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. 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. Seal penetration with firestopping materials to match existing fire rating.

F. 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 with firestopping materials to match existing fire rating.

3.5 DUCT AND PLENUM INSULATION INSTALLATION

A. 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 overcompress 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.
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.

B. Board 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, space 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 overcompress insulation during installation.
    e. 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. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows.
6. 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.

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. 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.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply vapor-barrier mastic to open ends, joints, seams, breaks, and punctures in insulation. 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. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.

2. Seal longitudinal seams and end joints.

C. 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 aluminum, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.7 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. Secure single-layer insulation with bands at 12-inch intervals and tighten bands without deforming insulation materials.

C. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with bands at 12-inch intervals.

D. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

E. Cover segmented insulated surfaces with a layer of insulating 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.

F. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

G. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

H. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
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 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.
5. 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.

I. 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 same insulation material and 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.
5. 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.

J. Insulation Installation on Pipe Fittings and Elbows:

1. 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. Factory-supplied pre-cut inserts are acceptable.
2. 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. Factory-supplied pre-cut inserts are acceptable.

K. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. 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.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. 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. For below ambient services, provide a design that maintains vapor barrier.

5. Install insulation to flanges as specified for flange insulation application.

L. 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.

M. 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.

N. Special Installation Requirements for Flexible Elastomeric and Polyolefin Insulation:

1. 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.
2. Insulation Installation on Pipe Flanges:

    a. Install pipe insulation to outer diameter of pipe flange.
    b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
    c. 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.
    d. 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.

3. Insulation Installation on Pipe Fittings and Elbows:

    a. Install mitered sections of pipe insulation.

b. 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.

3.8 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-retarder 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. Provide metal jackets for all outdoor piping.

3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies to maintain existing fire rating.

3.10 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material:

1. Where required by the contract documents, Contractor responsible for this work shall apply two finish coats of interior, flat, latex-emulsion size over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof. Refer to General Contractor for responsibility.

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 Owner. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum jackets.

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect ductwork, randomly selected by Engineer or Construction Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Engineer or Construction Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer or Construction Manager, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

C. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.12 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in non-conditioned space.
4. Indoor, exposed return located in non-conditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.

2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Refrigerant exhaust duct.
9. Fabric duct.

3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. General: Insulation materials and thicknesses are as identified below. Refer to Division 23 Section "Metal Ducts" and contract drawings for both rectangular and spiral duct systems required duct liner or where double-wall ductwork is required.

B. Concealed, Supply-Air and Outdoor-Air (Treated) Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density (R-4.2).

C. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density (R-4.2).

D. Concealed, Outdoor-Air (Untreated) Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density (R-4.2).

E. Concealed, Exhaust Air (Energy Recovery Only) Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 3-lb/cu. ft. nominal density (R-4.2).

F. Exposed, Supply-Air and Outdoor-Air (Treated) Duct and Plenum Insulation: Mineral-fiber board, 1-inches thick and 3.0-lb/cu. ft. nominal density (R-4.3).

G. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 1-inches thick and 3.0-lb/cu. ft. nominal density (R-4.3).

H. Exposed, Outdoor-Air Duct (Untreated) and Plenum Insulation: Mineral-fiber board, 1-inches thick and 3-lb/cu. ft. nominal density (R-4.3).

I. Exposed, Exhaust-Air Duct (Energy Recovery Only) and Plenum Insulation: Mineral-fiber board, 1-inches thick and 3-lb/cu. ft. nominal density (R-4.3). Note: All other general exhaust-air (non-energy recovery) duct in system is non-insulated.

J. Concealed, Transfer Air Duct: Elastomeric Duct Liner, 3/4" Thick.

K. Concealed and Exposed, Grease Duct: Fire Rated Insulation System, 2 inches thick.

L. Concealed and Exposed, Supply Air Duct within 18" of the Kitchen Hood: Fire Rated Insulation System, 2 inches thick.

3.14 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. General: Insulation materials and thicknesses are as identified below. Refer to Division 23 Section "Metal Ducts" and contract drawings for both rectangular and spiral duct systems required duct liner or where double-wall ductwork is required.

B. Exterior ductwork shall have insulation sloped to one side to ensure proper water runoff. Refer to Section 3.20 for outdoor jacketing requirements.

C. Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density (R-13).

D. Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density (R-13).

E. Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density (R-13).

F. Exhaust-Air Duct (Energy Recovery Only) and Plenum Insulation: Mineral-fiber board, 3 inches thick and 3-lb/cu. ft. nominal density (R-13).

G. Grease Duct and Plenum Insulation: Fire Rated Insulation System, 2 inches thick.

3.15 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that are not factory insulated.

C. For Dual Temperature or Heat Pump Piping Systems insulate in accordance with more stringent of hot-water or chilled-water requirements noted below.

D. Chilled-water pump insulation shall be the following:

1. Mineral-fiber board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density designed to be removed for maintenance.

E. Chilled-water expansion/compression tank insulation shall be the following:

1. Mineral-fiber pipe and tank, 1-1/2 inches thick.

F. Chilled-water air-separator insulation shall be the following:

1. Mineral-fiber pipe and tank, 1-1/2 inches thick.

G. Hot-water expansion/compression tank insulation shall be the following:

1. Mineral-fiber pipe and tank, 2 inches thick.

H. Hot-water air-separator insulation shall be the following:

1. Mineral-fiber pipe and tank, 2 inches thick.

3.16 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. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
5. Refrigerant relief vent piping.
6. Hot Water Pumps.
7. Factory Insulated Equipment.

3.17 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and equipment drain piping (including all HVAC equipment, cooling coil condensate, boiler condensate, etc.): Mineral-Fiber pipe insulation, Type I, 1 inch thick.

1. Pipe size less than or equal to 1-1/4": Mineral-fiber, preformed pipe, Type I, 1/2 inch thick.
2. Pipe size greater than 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-inch thick.

B. Domestic Cold Make-Up Water: Mineral-fiber pipe insulation, Type I, 1-inch thick.

C. Chilled Water (Water or Glycol), above 40 to 60 Deg F:

1. Pipe size less than or equal to 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-1/2 inch thick.
2. Pipe size greater than 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-1/2-inch thick.

D. Heating-Hot-Water Supply and Return, 141 to 200 Deg F and below:

1. Pipe size less than or equal to 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-1/2 inch thick.
2. Pipe size greater than 1-1/4": Mineral-fiber, preformed pipe, Type I, 2-inch thick.

E. Dual Temperature Water and Condenser Water (Heat Pump), above 40 Deg F, less than 150 Deg F.:

1. Pipe size less than or equal to 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-1/2 inch thick.
2. Pipe size greater than 1-1/4": Mineral-fiber, preformed pipe, Type I, 1-1/2 inch thick.

F. Water Treatment bypass chemical feed: Insulation shall be provided to meet same characteristics as the system bypass feeder it is installed in.

G. Refrigerant Suction and Liquid Piping: Flexible elastomeric, Type I, Grade 3, 1/2 inch thick.

3.18 OUTDOOR PIPING INSULATION SCHEDULE

A. Domestic Water Make-up Piping: Mineral-fiber, preformed pipe, Type I, 2 inches thick.

B. Chilled Water (Water or Glycol) and Condenser Water (Heat Pump) Piping:

1. Flexible Elastomeric, preformed pipe, Type I, Grade 3, 3 inches thick, or
2. Mineral-fiber, preformed pipe, Type I, 2 inches thick.

C. Heating Hot Water Piping: Mineral-fiber, preformed pipe, Type I, 2 inches thick.

D. Refrigerant Suction and Liquid Piping: Flexible Elastomeric, preformed pipe, Type I, 1 inches thick with manufacturer applied finish.

3.19 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: None; Manufacturer All-Service Jacket Only.

D. Ducts and Plenums, Exposed: None; Manufacturer All-Service Jacket Only.

E. Piping, Concealed: None; Manufacturer All-Service Jacket Only.

F. Piping, Exposed: PVC, 20 mils thick on fittings only for piping systems outside of the Mechanical Room. For piping within the Mechanical Room, provide PVC, 20 mils thick on piping and fitting for a height of 6’-0” above the finished floor. Piping above 6’-0” shall receive PVC, 20 Mils thick on fittings only.

G. Pumps (Chilled Water or Dual Temperature Only), Exposed: PVC, 30 mils thick for removable pump insulation box.

3.20 OUTDOOR, 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:

1. VentureClad 1577CW Jacketing System, or approved equivalent, for outdoor application.
2. White EPDM, Sealed Air and Water Tight.

D. Piping: Jacketing shall be one of the following:

1. PVC, 20 mils thick.
2. Aluminum, corrugated with z-shaped locking seam, 0.016 inch thick.

END OF SECTION 230700

SECTION 230710

PENETRATION FIRESTOPPING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to work specified in this section.

1.2 DEFINITIONS

A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

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

A. Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
B. Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

1.4 RELATED WORK OF OTHER SECTIONS

A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including, but not limited to:

1. Section 078413 – Penetration Firestopping.

1.5 REFERENCES

A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops"

B. Test Requirements: UL 1479, “Fire Tests of Through-Penetration Firestops”

C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

1. UL Fire Resistance Directory:

a. Firestop Devices (XHJI)
b. Fire Resistance Ratings (BXRH)
c. Through-Penetration Firestop Systems (XHEZ)

d. Fill, Voids, or Cavity Material (XHHW)
e. Forming Materials (XHKU)

D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

E. Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”

F. ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials.”

G. International Building Code 2009, NJ Edition.

H. NFPA 101 - Life Safety Code

1.6 QUALITY ASSURANCE

A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

B. Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.7 SUBMITTALS

A. Submit Product Data: Manufacturer’s specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.

B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor’s name who will install firestop system as described in drawing.

C. Submit material safety data sheets provided with product delivered to job-site.

1.8 INSTALLER QUALIFICATIONS

A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

B. Installation Responsibility: assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

C. The work is to be installed by a contractor with at least one of the following qualifications:

FM 4991 Approved Contractor
UL Approved Contractor
Hilti Accredited Fire Stop Specialty Contractor

D. Firm with not less than three years of experience with fire stop installation.

E. Successfully completed not less than three comparable scale projects using similar systems.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

A. Do not use materials that contain flammable solvents.

B. Scheduling

1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 FIRESTOPPING - GENERAL

A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

D. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
2. T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

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

F. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Hilti, Inc.
2. Or approved equivalent.

2.3 MATERIALS

A. Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems) penetrating concrete floors and/or gypsum walls, the following products are acceptable:

1. Hilti Cast-In Place Firestop Device (CP 680-P) for use with combustible penetrants.
2. Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
3. Hilti Firestop Speed Sleeve (CP 653) for use with cable penetrations.
4. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
5. Hilti Firestop Block (CFS-BL)

C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

1. Hilti Intumescent Firestop Sealant (FS-ONE MAX)
2. Hilti Fire Foam (CP 620)
3. Hilti Flexible Firestop Sealant (CP 606)

D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:

1. Hilti Flexible Firestop Sealant (CP 606)
2. Hilti Intumescent Firestop Sealant (FS-ONE MAX)

E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:

1. Hilti Intumescent Firestop Sealant (FS-ONE MAX)

F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:

1. Hilti Intumescent Firestop Sealant (FS-ONE MAX)
2. Hilti Fire Foam (CP 620)
3. Hilti Flexible Firestop Sealant (CP 606)

G. Non-curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:

1. Hilti Firestop Putty Stick (CP 618)
2. Hilti Firestop Plug (CFS-PL)

H. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:

1. Hilti Firestop Collar (CP 643N)
2. Hilti Firestop Collar (CP 644)
3. Hilti Wrap Strips (CP 648E/648S)

I. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

1. Hilti Firestop Mortar (CP 637)
2. Hilti Firestop Block (CFS-BL)
3. Hilti Fire Foam (CP 620)
4. Hilti Firestop Board (CP 675T)

J. Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

1. Hilti Firestop Block (CFS-BL)
2. Hilti Firestop Board (CP 675T)

K. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:

1. Hilti Firestop Block (CFS-BL)
2. Hilti Firestop Plug (CFS-PL)

L. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

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

3.2 COORDINATION

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

B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 INSTALLATION

A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.

1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
3. Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.

D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 IDENTIFICATION & DOCUMENTATION

A. The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.

1. The Documentation Form for through penetrations is to include:

a. A Sequential Location Number
b. The Project Name
c. Date of Installation
d. Detailed description of the penetrations location
e. Tested System or Engineered Judgment Number
f. Type of assembly penetrated
g. A detailed description of the size and type of penetrating item
h. Size of opening
i. Number of sides of assemblies addressed
j. Hourly rating to be achieved
k. Installers Name

B. Copies of these documents are to be provided to the general contractor at the completion of the project.

C. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's Name, address, and phone number.
3. Through-Penetration firestop system designation of applicable testing and inspecting agency.
4. Date of Installation.
5. Through-Penetration firestop system manufacturer's name.
6. Installer's Name.

3.6 ADJUSTING AND CLEANING

A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION 230710

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL SUMMARY OF WORK

A. This Section includes instrumentation for HVAC systems and components located at Atlantic Cape Community College Worthington Campus as identified in this Section and the related documents referenced below.

1. This contractor shall provide control panels, devices and controllers, etc. for existing, new or modified equipment specified within this contract and shall responsible to coordinating/interfacing with BAS contractor to make points available for connection to the existing BAS system.

2. **It is the intent of this specification to extend the existing campus wide Honeywell International Building Automation system that is operational on the College's Campuses and provide programming, integration and graphics for all modified systems noted within the work. All existing control systems, not being replaced under this contract shall remain in place and functional. Refer to Section 230993 "Sequence of Operations for HVAC Controls" for additional clarification.** Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high-speed, peer-to-peer network of Direct Digital Controls, routers, repeaters, and electronic interfaces and actuation devices, as required to meet the scope of work. Drawings are diagrammatic only and describe the basic intent. Equipment and labor not specifically referred to here or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner. **Performance and capabilities are based on the Honeywell Building Solutions Building Automation System (BAS) or approved equal.**

3. The Existing Building Automation System on the Campus is a Enterprise Building Integrator (EBI) by Honeywell. The existing BAS shall be expended and modified to seamlessly integrate the new equipment notes as part of this project. All new controls shall be compatible with the Honeywell EBI. The contractor shall coordinate with the Existing BAS System providers for the College and include all associated costs in their bid. The Existing BAS System Service provider is Honeywell, 534 Fellowship Road Mount Laurel, NJ 08054. Contact Information: Ed.Mogck@honeywell.com, (856) 437-1847.

B. All new controls shall be integrated into the existing Honeywell International Building Automation System at the facility and utilize the Honeywell EBI Product Line or approved equal. Provide Honeywell system expansion, point assignment and programming required to provide all new control points to the existing Honeywell BAS system. Provide all new graphics and point assignments required to provide a complete integrated BAS system.

C. Related Sections include the following:

1. Division 23 Section "Meters and Gages" for measuring equipment that relates to this Section.

2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
   a. The points list and sequence of operations is found in Section 23 “Sequence of Operations for HVAC Controls” and the respective equipment specification sections.

D. Related Contract Documents include the following:

1. Mechanical and electrical construction drawings as included within the contract documents.

1.3 SPECIFIC SUMMARY OF WORK

A. Work described in this Section shall be installed, wired, circuit tested, and calibrated by factory-certified and employed technicians qualified for this work and in the regular employment of the temperature control system manufacturer.

B. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high-speed, peer-to-peer network of Direct Digital Controls, routers, repeaters, and electronic interfaces and actuation devices, as shown on the drawings and as described herein. All existing control systems, not being replaced under this contract shall remain in place and be extended to incorporate the new systems. Drawings are diagrammatic only. Equipment and labor not specifically referred to here or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner. Performance and capabilities are based on the Honeywell International Enterprise Building Integrator (EBI) suite utilizing Honeywell Comfort Point Open Controls Products Line.

C. All new controls shall be integrated into the existing Honeywell International Enterprise Building Integrator (EBI) package. Provide EBI system expansion, point assignment and programming required to provide all new control points to the existing EBI system. Provide all new graphics and point assignments required to provide a complete integrated EBI system.

1.4 PROJECT SCHEDULING

A. BAS Contractor shall schedule all work through the Prime Contractor. Prime Contractor shall schedule directly with Owner or Owner’s representative. At a minimum, the BAS Contractor shall submit the following to the Prime Contractor for submission to the Owner:

1. Within one month of contract award, provide a schedule of the work indicating the following:
   a. Intended sequence of work items
   b. Start dates of individual work items
   c. Duration of individual work items
   d. Planned delivery dates for major material and equipment, and expected lead times
   e. Milestones indicating possible restraints on work by other trades or situations

2. Provide monthly written status reports indicating work completed and revisions to expected delivery dates. An updated project schedule shall be included.

1.5 APPROVED CONTROL SYSTEM MANUFACTURERS

A. The following are the approved control system manufacturers as specified:

1. Honeywell International, 534 Fellowship Rd, Mt. Laurel NJ; Comfort Point Open Protocol Controls Product Line or approved equal.

2. The installing Contractor shall only use products corresponding to the product line listed and/or approved by the Owner via the substitution process.

3. The manufacturer listed above applies to all client and server software, programming, controller software, computer-generated custom application programming, general purpose and unitary controllers.

1.6 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1 deg F.
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 deg F.
    e. Ducted Air Temperature: Plus or minus 1 deg F.
    f. Outside Air Temperature: Plus or minus 2 deg F.
    g. Dew Point Temperature: Plus or minus 3 deg F.
    h. Temperature Differential: Plus or minus 0.25 deg F.
    i. Relative Humidity: Plus or minus 5 percent.
    j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch wg.
    n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
    o. Carbon Dioxide: Plus or minus 50 ppm.
    p. Electrical: Plus or minus 5 percent of reading.

1.7 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
1. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135 BACnet communication protocol.

D. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

E. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

F. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

H. Qualification Data: For Installer and manufacturer. Refer to Section above for requirements.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Basic Requirements:
   a. Maintenance instructions and lists of spare parts for each type of control device.
   b. Interconnection wiring diagrams with identified and numbered system components and devices.
   c. Keyboard illustrations and step-by-step procedures indexed for each operator function.
   d. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   e. Calibration records and list of set points.

1.8 QUALITY ASSURANCE

A. General

1. BAS Contractor shall be a direct factory branch office or authorized representative for manufacturer of Front End Software, DDC System Hardware and other related systems. Installing office shall have a minimum of ten years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer.
2. BAS Contractor shall have a minimum of ten (10) years' experience as an ATC installing contractor.
3. Bids by wholesalers, dealers or any other firms not authorized to provide, install, service and maintain Honeywell Enterprise Building Integrator Product Line HVAC Controls will not be acceptable.
4. All work described in this section shall be installed, wired, circuit tested, and calibrated by factory-certified technicians qualified for this work and in the direct employment of the temperature control system manufacturer. BAS Contractor shall provide 100 percent of all services with company personnel. No portion of services can be subcontracted to others without express written permission of the Owner; with such permission, all specifications, terms, and conditions specified herein shall be the responsibility of the Prime Contractor.
5. BAS Contractor / manufacturer shall have a solid reputation of installing, servicing and maintaining "open protocol" Control systems that are compliant with servicing multiple manufacturers over a standard I/P protocol (BACnet).
6. BAS Contractor shall have a local branch facility within a 50-mile radius of the job site. Emergency service shall be available on a 24-hour, 7-day-a-week basis.
7. BAS Contractor will coordinate with other Trade Contractors regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, and so forth, in order to eliminate any delays in the progress of the job.
8. BAS Contractor shall complete work necessary to allow the Test and Balance Contractor to perform work in a timely manner. The BAS Contractor shall complete all work necessary to allow operation and demonstration of variable frequency drives.

B. Experience Record

1. The BAS Contractor shall have a minimum of ten years' experience with the complete, turnkey installation of BAS Control Systems of similar size and technical complexity.

C. Products

1. Controller and DDC (Direct Digital Control) system components shall be current production products.

D. ISO-9001

1. The manufacturer of the BAS Control System shall provide documentation supporting compliance with ISO-9001 (Model of Quality Assurance in Design/Development, Production, Installation, and Servicing).

E. Quality Assurance Program

1. The BAS Contractor shall assign a single individual to serve as the Quality Assurance Manager, who is to be responsible for the management of the program.

F. Governing Code Compliance

1. The BAS Contractor shall comply with all current governing codes ordinances and regulations, including UL, NFPA, the local Building Code, NEC, and so forth.

G. FCC Regulation

1. All electronic equipment shall conform to the requirements of FCC Regulation, Part 23, Section 23, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

H. 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.

I. Comply with ASHRAE 135 for DDC system components.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

D. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

E. Inter-Divisions Coordination

1. The BAS Contractor shall cooperate with other divisions performing work on this project as necessary to achieve a complete and neat installation. The Contractor shall also consult the drawings and specifications of all trades to determine the nature and extent of others' work. It will be the duty of this Contractor to work in cooperation with other contractors, and with other sub-contractors and employees, rendering assistance and arranging his or her work so that the entire project will be delivered in the best possible condition and in the shortest time.

2. If the BAS Contractor, upon completing coordination with other divisions performing work on this contract is under the assumption that there are still open issues that restrict he or she from completing their work, he or she must alert both the Owner's representative of the problem in a timely manner.

1.11 WARRANTY

A. Warrant all work as follows:

1. Labor and materials for the control system specified shall be warranted free from defects for a period of 24 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.
2. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multiphase contract, then each contract or phase shall have a separate warranty start date and period.
3. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this Specification. The date of acceptance shall be the start of warranty.

    a. Exception: Contractor shall not be required to warrant reused devices, except for those that have been rebuilt or repaired. Contractor shall warrant all installation labor and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of the Engineer's acceptance.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:

1. Project graphic images.
2. Record drawings.
3. Project database.
4. Project-specific application programming code.
5. All documentation.

1.13 DEFINITIONS

A. BAS: Direct Digital Control, Automatic Temperature Control.

B. BAS Contractor: Reference to the Contractor completing field installation of the HVAC Controls. Prime Contractor is responsible for all work performed by sub-contractors and included within this Section.

C. I/O: Input/output.

D. PID: Proportional plus integral plus derivative.

E. RTD: Resistance temperature detector.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The basic controls system also includes all sensors, controllers, instruments, valves, actuators, devices, installation and service for a complete and functional controls system. All control devices (valves, dampers, actuators, etc.) are included under the contract unless specifically specified elsewhere in the contract documents.

B. The Installed system shall provide secure password access to all features, functions and data within the overall FMS in a defined hierarchy.

2.2 OPEN, INTEROPERABLE INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide an Open System solution that utilizes industry standard communications protocols consisting of peer-to-peer networked, stand-alone, distributed controls in compliance with ANSI/ASHRAE Standard 135-1995/2004 BACnet® communication protocol in one open, interoperable system. Open System communication protocols shall be utilized Top-to-Bottom from front-end Graphical User Interface (GUI) to the field level distributed controllers. Proprietary communications, objects, or communication "Tiers" are not acceptable allowing highest level of interoperability between control devices and systems.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995/2004 BACnet® to assure interoperability between all system components is required. For all native BACnet® device, the device supplier must provide a PICS document showing the installed device's compliance level, or BIBB's listing supported objects, properties, and services. All native BACnet® Controllers should confirm to BIBB's profile for B-BC, B-ASC, B-AAC as applicable with the ability to support minimum data read and write functionality listed in the associated control drawings and points list.. Physical connection of BACnet® devices shall be via Ethernet utilizing BACnet® over IP without the need for additional hardware viz. routers and / or gateways.

C. All network controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Plant controllers requiring "polling" by a host to pass data shall not be acceptable.

D. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting BACnet®, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, a local host computer system.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
2. Cable; 10 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

2.4 PACKAGING AND ENVIRONMENTS

A. Distributed unitary controller enclosures (panels) shall be locking type, metal cabinet, with common keying. The panels shall have a metal print pocket suitable for storing wiring, service and log information. Indoor panels shall be NEMA 1 enclosures with gaskets. Any panels in cooling tower or chemically treated areas shall be stainless steel (Fiberglass enclosures rated for outside applications are acceptable).

B. The panel, when required, must functionally operate over a temperature range of 0 to 50, and a humidity range of 0 - 93% non-condensing.

C. DDC panels shall come with a minimum of six pre-existing available knockouts for ease of wiring during installation.

D. The electrical requirements shall be identified and coordinated by the BAS Contractor. Any 230 VAC requirements are to be coordinated with Electrical Contractor. The Electrical Contractor shall provide 230 VAC power circuits to each panel. 230 VAC power should not be installed in the same panel as 24 VAC. However, if 230 VAC power must be installed in the same panel with 24 VAC power due to design and/or system constraints, the 230 VAC side of the panel shall be physically isolated from the 24VAC side and clearly labeled. Use raceways (Panduit or equivalent) in each control panel to conceal all wiring. Fuse all transformers.

E. Control panels shall be clearly identified by labels with 2” high lettering.

F. Provide and install as-built wiring diagrams to indicate the control points on all equipment. Also provide laminated point lists in all control panels.

2.5 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion.

2.6 CONTROL UNITS

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.

c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
d. Boiler Control Programs: Control function of hot-water reset and equipment sequencing.
e. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
f. Include additional programs as required to provide sequences as described in Section 23 "Sequence of Operations for HVAC Controls."
g. Remote communications.
h. Maintenance management.
i. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.

5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 230 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 230 dB at 40 to 100 Hz.

2.7 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.8 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.

4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.9 TIME CLOCKS

A. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.10 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5 deg F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches to 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 36 to 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: White.
    e. Orientation: Vertical.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches to 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 18 to 48 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: White.
    e. Orientation: Vertical.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Accuracy: 2 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: White.
    e. Orientation: Vertical.

4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    d. Duct Static-Pressure Range: 0- to 5-inch wg.

2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 230-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 230-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.
4. Color: White.
5. Orientation: Vertical.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

2.11 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 90 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.12 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF".
2. Mount on single electric switch box.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

a. Time of day.
b. Actual room temperature.
c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.

f. Day of week.
g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

G. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

H. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

I. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

K. Single Zone – Fan Coil & UV
1. 3 degrees plus 3 degrees minus heating/cooling controllability.

2. Low voltage.
3. Occupied override button.
4. Temperature setpoint and space temperature readout.
5. Locking cover.

L. Single Zone – CUH/Finned Tube Baseboard
1. 3 degrees plus 3 degrees minus heating controllability.
2. Low voltage.
3. Temperature setpoint and space temperature readout.
4. Locking cover.

2.13 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Motors."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 230 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 230 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 230 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 230 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:

    a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24-V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: Minus 22 to plus 122 deg F.
10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
11. Run Time: 12 seconds open, 5 seconds closed.

2.14 DAMPERS

A. Dampers: AMCA-rated, parallel and opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

B. Refer to Division 23 Section “Air Duct Accessories” for further information.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 26 Section " Low Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

C. The Contractor shall examine the drawings and specifications for other parts of the Work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the Contractor’s work, and the plans and the work of others—the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor’s work with the work of others. Any changes in the work covered by this Specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by—and at the expense of—this Contractor.

D. Contractor shall verify that power supply is available to control devices and is correct voltage and phase prior to proceeding.

E. Contractor shall verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 PROTECTION OF WORK

A. The Contractor shall protect all work and material from damage from its work or employees, and shall be liable for all damages thus caused.

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Division 23 Section "Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical Identification."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

J. Install electronic and fiber-optic cables according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

3.4 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer’s recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported. Additionally, the wiring to the sensor shall not be required to be polarity sensitive. The design of the sensor shall be modular, which allows for the rough-in of all wiring without the presence of the electronics or esthetic covering.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Sensors used in mixing plenums and in hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 ft of sensing element for each square ft of coil area.

G. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on the north wall, complete with sun shield at designated location.

3.5 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install equipment, piping, and wiring raceway parallel to the building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electric Code (NEC).

D. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."

E. Install building wire and cable according to Division 26 Section "Conductors and Cables."

F. Install signal and communication cable according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

G. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

H. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.6 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Adjust flow switch in accordance with manufacturer’s instructions.

3.7 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

B. Check operation of damper and actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

C. Provide all mounting hardware and linkages for actuator installation.

D. Electric and electronic actuators:

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. Actuators shall be mounted following manufacturer's recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.8 CONTROLLERS

A. Reuse all existing Honeywell panels as currently installed throughout the College.

B. Provide new controllers, as required, to accommodate new controls points. New controllers shall be compatible with existing Honeywell equipment.

3.9 FRONT END UPGRADE AT EACH FACILITY

A. Reuse to extent possible existing College-owned Honeywell International front end servers / graphics, etc., located at the existing College facilities.

B. Provide all required software upgrades and licenses for integration of old and new control systems into the Honeywell Controls Platform.

C. Provide all programming and graphic design for update into the College-wide Honeywell EBI system.

3.10 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25 percent of available memory free for future use.

B. Point naming and point value: System point names and values shall be of sufficient size to allow flexibility in design, allowing easy operator interface without the use of a written point index or cryptic alphanumeric shorthand.

1. Point ID is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment. Point ID shall be a minimum of 40 characters in length.
2. Point descriptors shall be a minimum of 132 characters.
3. Point states shall be a minimum of 8 characters in length.
4. Point engineering units shall be a minimum of 6 characters in length.
5. Point values shall be a minimum of 15 characters in length with a variable decimal point.

C. Software programming:

1. Provide programming for the system and adhere to the sequences of operation provided. Imbed into the control program sufficient comment statements to clearly describe each section of the program.
2. Graphic-based:
   a. Shall provide actions for all possible situations.
   b. Shall be documented in the form of a logic flowchart.
3. Text based:
   a. Shall provide actions for all possible situations.
   b. Shall be modular and structured.
   c. Shall be commented.
4. Parameter-based:
   a. Shall provide actions for all possible situations.
   b. Shall be documented.

D. Operator interface:

1. Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
2. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports; test reports shall include a log showing the date, technician's initials, and any corrective action taken or needed:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest. Insure all normal and fail-safe positions are correct.
2. Test and adjust controls and safeties.
   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.

6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.12 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.13 CLEANING

A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, and crates under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the Contractor shall clean all of its work and equipment, keeping it free from dust, dirt, and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Training for HVAC Controls shall be included for a total of 8 hours; (2) 4-hour sessions. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 230923

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination variable frequency controllers (VFCs), rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 DEFINITIONS

A. BAS: Building automation system.

B. CPT: Control power transformer.

C. EMI: Electromagnetic interference.

D. IGBT: Insulated-gate bipolar transistor.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. MCP: Motor-circuit protector.

H. NC: Normally closed.

I. NO: Normally open.

J. OCPD: Overcurrent protective device.

K. PCC: Point of common coupling.

L. PID: Control action, proportional plus integral plus derivative.

M. PWM: Pulse-width modulated.

N. RFI: Radio-frequency interference.

O. TDD: Total demand (harmonic current) distortion.

P. THD(V): Total harmonic voltage demand.

Q. VFC: Variable-frequency motor controller. Also, referenced as variable frequency drive (VFD) on the contract documents.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Enclosure types and details.
d. Nameplate legends.
e. Short-circuit current (withstand) rating of enclosed unit.
f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For each VFC, from manufacturer.

D. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

E. Source quality-control reports.

F. Field quality-control reports.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical systems without Construction Manager's written permission.
4. Comply with NFPA 70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.
2. Ratings and characteristics of supply circuit and required control sequence.
3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.11 WARRANTY

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

1. Warranty Period: One year from date of Substantial Completion or eighteen months from shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Danfoss; VLT Series HVAC drives or comparable product by one of the following:

1. ABB.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.
5. Square D; a brand of Schneider Electric.
6. Yaskawa.
7. Or approved equivalent.

B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: Constant and Variable torque.

D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
8. Ambient Storage Temperature Rating: Not less than minus 13 deg F and not exceeding 149 deg F
9. Humidity Rating: Less than 95 percent (noncondensing).
10. Altitude Rating: Not exceeding 3300 feet.
11. Vibration Withstand: Comply with IEC 60068-2-6.
12. Overload Capability: 1.5 times the base load current for 60 seconds.
13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
14. Speed Regulation: Plus or minus 5 percent.
15. Output Carrier Frequency: Selectable; 3 to 14 kHz.
16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.
2. Signal: Pneumatic.

J. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 3,600 seconds.
4. Deceleration: 0.1 to 3,600 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
3. NC alarm contact that operates only when circuit breaker has tripped.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

    a. A minimum of two programmable analog inputs: 0- to 10-V dc.
    b. A minimum of six multifunction programmable digital inputs.

2. Pneumatic Input Signal Interface: 3 to 15 psig.
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

    a. 0- to 10-V dc.
    b. 4- to 20-mA dc.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.

4. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:

    a. Output frequency (Hz).
    b. Output current (load).
    c. DC-link voltage (V dc).
    d. Motor torque (percent).
    e. Motor speed (rpm).
    f. Set point frequency (Hz).

5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).

d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms and energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.
2. Embedded BAS Protocols for Network Communications: BACnet, Modbus RTU, Johnson Controls Metasys N2, Siemens Apogee FLN or LON accessible via additional communication card. Contractor to coordinate with controls vendor and equipment vendor shall supply project specific communication card.

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Provide 5 percent dual DC link reactors.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.4 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.

C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Full-voltage (autotransformer) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
    b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

6. Overload Relays: NEMA ICS 2.

    a. Solid-State Overload Relays:

        1) Switch or dial selectable for motor-running overload protection.
        2) Sensors in each phase.
        3) Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
        4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
        5) Analog communication module.

    b. NO isolated overload alarm contact.
    c. External overload reset push button.

2.5 OPTIONAL FEATURES

A. Damper control circuit with end of travel feedback capability.

B. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

C. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

D. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

E. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Kitchen and Wash-Down Areas: Type 3R.
4. Other Wet or Damp Indoor Locations: Type 3R.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

a. Push Buttons: Covered types; maintained.
b. Pilot Lights: LED types; push to test.
c. Selector Switches: Rotary type.
d. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R or Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cooling Fan and Exhaust System: For NEMA 250, Type 1 or Type 12; UL 508 component recognized: Supply fan, with stainless steel intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

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

3.2 HARMONIC ANALYSIS STUDY

A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze designated operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification.

3.3 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

C. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in control circuits if not factory installed.

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges.

F. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Training for VFCs shall be included for a total of 1 hours; (1) 1-hour sessions.

END OF SECTION 230923

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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 control sequences for HVAC systems, subsystems, and equipment.

B. Related sections include the following:

1. Division 23 section "instrumentation and control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. DDC: Direct Digital Control.

B. VAV: Variable Air Volume.

C. BMS: Building Management System

D. VFD: Variable Frequency Drive

1.4 SYSTEM DESCRIPTION

A. The control sequences below describe all necessary equipment operation including those operations that are provided by the HVAC equipment manufacturers and those as part of the central control system. Refer to individual equipment specifications for devices provided by the HVAC equipment manufacturers. It is the responsibility of the mechanical contractor to provide a fully coordinated and operational control system.

B. All thermostats, sensors etc. whether provided by the HVAC equipment manufacturer or the controls manufacturer shall be provided with matching locking metal covers by the controls manufacturer in order to prevent unauthorized tampering and vandalism.

C. Electrical contract work will include 460/277/220/208/120 volt power wiring to motors, HVAC equipment, and control panels.

D. Mechanical contract work will include all control wiring. Power supply wiring to all actuators (valves, dampers, etc.), including low voltage transformers, shall be provided as part of the mechanical contract.

1.5 GENERAL EXHAUST FANS (EF/GEF/KEF)

A. General exhaust fan shall be controlled as follows:

1. Bathroom and general exhaust fans shall operate continuously.
2. KEF's serving dishwashers shall be interlocked with operation of their associated dishwasher.
3. KEF's serving condensate hoods shall be controlled by their associated hood's switch.
4. Ceiling mounted EF's serving a stand alone bathroom shall be controlled by wall switch.

B. Upon activation of exhaust fan, where applicable, interlock the operation of the exhaust fan with the fan's associated exhaust air motor operated damper (MOD) by use of an end switch. Exhaust air fan shall not energize until exhaust damper is fully open. Upon de-energizing of exhaust fan, exhaust damper shall automatically close.

C. Provide current proof-of-flow switch for exhaust fans' motors.

D. ATC contractor shall provide all materials and labor necessary to interface new exhaust fans into the facility's BMS. Provide both monitoring and override control by the BMS, of the unit's operations. The BMS shall monitor status and provide control of the following points:

1. Fan status.

1.6 ROOFTOP AIR HANDLING UNITS (RTU) – SINGLE ZONE VARIABLE AIR VOLUME (SZVAV)

A. Packaged rooftop energy recovery air handling unit shall consist of a gas fired furnace, dx cooling coil, supply air fan with variable frequency drive, exhaust air fan with variable frequency drive and economizer damper. Provide rooftop unit with a controller capable of performing sequence of operations described below. The unit's controller shall also be capable of controlling it's associated VAV boxes.

B. cooling functions shall be governed by the same controller. Provide a discharge air temperature sensor and a carbon dioxide sensor (see schedule for units) in the return air ductwork.

C. Occupied mode: when the system is indexed to occupied mode, outdoor air damper shall open to its occupied position (100% of required outside air, adj.), return air damper modulate inversely to the outdoor air damper, and supply air fans shall energize and operate continuously. The heat wheel is activated and the heat wheel exhaust fans are started.

a. Temperature and fan control: When space temperature equals it control setpoint, supply and return air fans shall operate at their low limit speed setpoints (50% adj.) And the unit's cooling coil and heating circuits shall modulate as required to maintain nominal discharge air temperature of 70°f (adj.). On a rise in space

temperature above setpoint, the heating system shall shut off and the cooling circuit shall stage on as necessary to maintain supply air discharge temperature of 55°f (adj.). On a continued rise in space temperature above setpoint, the unit's supply and return air fans speeds shall modulate up to their 100% high limit speed setpoints and the cooling circuit shall continue to stage on as necessary to maintain discharge air temperature of 55 °f (adj.). On a fall in space temperature below setpoint, the reverse sequence shall occur until the cooling circuit is off and the supply and return air fans are operating at their low limit speed setpoints. On a continued fall in space temperature below setpoint, the cooling circuit shall remain off, and the heating system shall modulate on to maintain a discharge temperature of 90°f (adj.). On a continued fall in space temperature below setpoint, the supply and return air fans speeds shall continue to modulate up to their 100% high limit speed setpoints and the heating system shall continue to modulate on as necessary to maintain discharge air temperature of 90°f (adj.). On a fall in space temperature below setpoint, the reverse sequence shall occur until the heating system is off and the supply and return air fans are operating at their low limit speed setpoints.

D. Humidity Control (Occupied Mode Only): If space humidity rises above 55% rh, as sensed by room or return air humidity sensor, unit shall engage hot gas reheat dehumidification operation.

E. Economizer mode: if, during the occupied mode, the enthalpy of the outdoor air is desirable as sensed by the unit's internal differential enthalpy control, the outside air damper shall modulate fully open and the unit's power exhaust fan shall continue to run. If the outdoor enthalpy moves to an undesirable level, the reverse sequence shall occur.

F. Carbon dioxide sensing: in all modes of operation, the co2 outside air control operation is transparent to the specific mode in which it is operating. With the exception of unit shutdown or unoccupied mode. When the unit is in occupied mode of operation, as long as the c02 level detected by the return air sensor is below the setpoint (1000 ppm), the outside air damper will remain in the minimum position. When the c02 levels rise above the setpoint (1000 ppm ADJ.), the sensor will modulate the outside air dampers open AND PORPORTIONALLY CLOSE RETURN DAMPERS IN UNISON as required to maintain the desired c02 level. During c02 override, the heating and mechanical cooling shall be enabled and operate as required to maintain the discharge air temperature.

G. Unoccupied mode: when the system is indexed to unoccupied mode, outdoor air damper shall close and the return air damper shall modulate 100% open. During cooling and heating seasons, unit shall remain off. During heating season unit shall modulate as required to maintain a space temperature of 60°f (adj.).

H. Smoke detectors: upon activation of a duct mounted smoke detector, outside air dampers shall close, unit shall deenergize and a signal shall be sent to the building's fire alarm system. See plans for locations.

I. Warm-Up Mode: when the air handling unit is indexed to its warm-up mode by the facility's BMS, the return air and supply air dampers shall fully open, the outdoor and relief air dampers shall remain fully closed, the supply and return air fans shall be energized to their 100% speed setpoint and the unit's heating and cooling systems shall modulate open as required to maintain a 55°f (adj.) discharge air temperature on a call for space cooling, or 90°f (adj.) discharge air

temperature on a call for space heating. Upon completion of warm-up mode, unit shall be automatically indexed to its occupied mode by the facility's BMS.

J. ATC contractor shall provide all materials and labor necessary to interface new units into the facility's BMS. Provide both monitoring and control by the BMS, of the unit's operations. The BMS shall monitor status and provide control of the following points:

1. Space temperature via room thermostat/sensor (monitor only).
2. Space temperature setpoint.
3. Supply fan VFD status.
4. Exhaust fan VFD status.
5. Return and outside air damper positions
6. Outside air temperature and enthalpy.
7. Return air temperature and enthalpy.
8. Discharge air temperature.
9. Supply Airflow Monitor.
10. CO2 Level monitor and alarm.
11. Cooling circuit status (monitor only).
12. Furnace status (monitor only).
13. Manufacturer's standard and optional alarms (monitor only).

1.7 ELECTRIC UNIT HEATERS AND WALL HEATERS SHALL BE STANDALONE CONTROL WITHOUT INTERFACE INTO THE FACILITY BMS.

1.8 DUCT MOUNTED ELECTRIC REHEAT COIL

A. Duct Mounted Coil shall be provided with a wall mounted temperature sensor with slidebar adjustment (±5°Deg).

B. ATC Contractor shall provide all materials and labor necessary to interface units into the facility’s BMS. Provide both monitoring and control by the BMS, of the unit’s operations. The BMS shall monitor status and provide control of the following points:

1. Space Temperature Setpoint.
2. Space Temperature (Monitor Only).
3. Electric heating coil status (Monitor Only).

END OF SECTION 230993

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.

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.
3. Division 23 Section “Mechanical Insulation” for insulation requirements for systems that do not require duct liner as noted within this Section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, duct sealing, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

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 for all systems indicated on drawings.
4. Elevation of 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. Seam, joint and wall penetration sealing class and product data.
10. Penetrations through fire-rated and other partitions.
11. Equipment installation based on equipment being used on Project.
12. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
13. Hangers and supports, including methods for duct and building attachment and vibration isolation.
14. Chiller and Boiler Plant Ventilation System
15. Chiller Plant Refrigerant Relief Ventilation System

C. 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. Penetrations of smoke barriers and fire-rated construction.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

F. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

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. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Stainless Steel Sheets: Type 304, 2B Finish.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

G. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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."

H. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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."

I. 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 4, "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 AND FLAT-OVAL 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. Lindab, Inc.
    b. McGill AirFlow, LLC.
    c. SEMCO, LLC.
    d. Or approved equivalent.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. 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.

D. 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.

E. 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 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

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

1. MKT Metal Manufacturing.
2. McGill AirFlow LLC.
3. Lindab, Inc.
4. Or approved equal.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
3. Where specified for specific applications, all joints shall be welded.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

1. Where specified for specific applications, all joints shall be welded.

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

H. Inner Duct: Minimum 24-gauge solid galvanized sheet steel.

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

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

1. MKT Metal Manufacturing.
2. McGill AirFlow LLC.
3. SEMCO, LLC.
4. Or approved equal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

1. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

a. Construct ducts of galvanized sheet steel unless otherwise indicated.
b. For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

2. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."

a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," 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."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

4. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and

Laterals," and Figure 3-6, "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."

C. Inner Duct: Minimum 24-gauge solid galvanized sheet steel.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2.5 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: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. 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.

2.6 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. Basis-of-Design Product: Subject to compliance with requirements, provide Johns-Manville; Linacoustic RC for rectangular ductwork and Spiracoustic Plus for round spiral ductwork or comparable product by one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Knauf Insulation.
c. Or approved equivalent.
d. Maximum Thermal Conductivity:

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. 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.
3. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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, and 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. 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.
7. 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.

8. 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. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
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.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. 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.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. 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.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

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 ducts 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.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. 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.

K. Comply with requirements in Division 23 Section "Air Duct Accessories" for installation of fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Sheet Metal Contractor shall submit their “Cleaning Procedures Standards” to the Design Build Contractor for review.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. 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 5-1, "Rectangular Duct Hangers Minimum Size," 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, channel supports, hanger straps or Gripple cables.

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.

3.5 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. Coordinate any ductwork that is required to be painted with architectural drawings and specifications. Sheet Metal Contractor shall fabricate exposed duct that needs to be painted with galvanneal steel.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
    a. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    b. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    c. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. All open end ducts shall be sealed prior to installation. All ductwork should be stored off the floor and avoid any contact with water.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

HVAC System:	Duct Type:	Static Pressure Construction Class	Seal Class	Sealing Applicable	Leakage Class	
					Rectangular Metal	Round Metal
RTU	SA, RA	2"	A	Note 4	6	3
EF	EA (Grease)	2"	A	Note 4	6	3
EF	EA	2"	A	Note 3	6	3
Ventilation Louver	OA	2"	C	Note 3	24	12

Notes:

1. Refer to SMACNA Tables for additional information.
2. Ventilation (Outside) Air shall be considered/constructed same as Supply Air.
3. Transverse Joints Only.
4. Joints, Seams and All Wall Penetrations.

B. For exhaust ducts connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet, No. 2B finish.

b. Concealed: Carbon-steel sheet.
c. Welded seams and joints.

C. For exhaust ducts connected to dishwashers, showers, moist areas, and science lab fume hoods utilize materials in compliance with ASTM a480/A480M: Type 304 and Type 316 stainless steel.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

E. Liner: Provide for full duct system. For exterior lined ductwork, provide internal lining plus external lining and jacketing to meet overall outdoor insulation R-value. For interior double-wall ductwork, refer to the contract drawings.

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Transfer Air Ducts: Fibrous glass, Type I, 1 inch thick.

F. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "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 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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 proportionately 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.
        4) Radius-to Diameter Ratio: 1.5.

    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.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke Dampers.
6. Combination fire and smoke dampers.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.
12. Wire mesh grilles.

1.3 SUBMITTALS

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

1. For all accessories specified, include construction details, dimensions, materials, finishes, bearings and compliance with applicable codes.
2. Performance: Show compliance with pressure drops or specific requirements noted.
3. Provide manufacturer's installation instructions.
4. For duct silencers/sound attenuators, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. 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. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Wiring Diagrams: For power, signal, and control wiring.

C. 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.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

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.

1. Galvanized Coating Designation: G60 G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. 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.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. 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:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Duro Dyne Inc.
4. Greenheck Fan Corporation.

5. Ruskin Company.
6. Vent Products Company, Inc.
7. Or approved equivalent.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm

D. Maximum System Pressure: 1-inch wg

E. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: galvanized steel, plated steel or aluminum, mechanically attached to blade.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. McGill AirFlow LLC.
d. Ruskin Company.
e. Vent Products Company, Inc.
f. Greenheck.
g. Lloyd Industries.
h. Or approved equivalent.

2. Standard leakage rating, with linkage outside airstream.
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. Single blade up to 6 inches blade width; multiple blades for width over 6 inches.
    b. Opposed-blade design for multiple blades dampers.
    c. Round or oval ducts: butterfly type.
    d. Stiffen damper blades for stability.
    e. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze or Molded synthetic.
    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, provide products by one of the following:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. McGill AirFlow LLC.
    d. Ruskin Company.
    e. Vent Products Company, Inc.
    f. Greenheck.
    g. Lloyd Industries.
    h. Or approved equivalent.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

    a. Single blade up to 6 inches blade width; multiple blades for width over 6 inches.
    b. Opposed-blade design for multiple blades dampers.
    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. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze or Molded synthetic.
    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: Aluminum.

2.4 CONTROL DAMPERS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Duro Dyne Inc.
4. McGill AirFlow LLC.
5. Ruskin Company.
6. Vent Products Company, Inc.
7. Young Regulator Company.
8. Greenheck.
9. Or approved equivalent.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Extruded Aluminum Channel, 0.125 inch thick.
3. Reinforced corners.

D. Blades:

1. Multiple blades with maximum blade width of 8 inches.
2. Parallel -blade design.
3. Extruded Aluminum.
4. 0.125 inch thick.
5. Blade Edging: Closed-cell neoprene edging.

E. Blade Axles: 1/2-inch- diameter; hex-shaped Plated steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Molded synthetic
2. 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.

2.5 FIRE DAMPERS

A. Manufacturers:

1. Greenheck.
2. McGill AirFlow Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.
5. Lloyd Industries.
6. Or approved equivalent.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

D. Provide only dynamic type dampers.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: Same gauge as duct thick and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Fusible Links: Replaceable, 165 deg F rated.

2.6 SMOKE DAMPERS

A. Manufacturers:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Or approved equivalent.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Loose for field-installation in ductwork within 5’-0” of damper.

D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted corners and mounting flange.

E. Blades: Roll-formed, airfoil, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.

F. Seals: Blade edge seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb shall be constructed of flexible stainless steel compression type seals.

G. Leakage: Class I.

H. Pressure and Velocity Rating: 4” w.c. and 2000 FPM.

I. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

J. Damper Motors: Two-position action.

K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

L. Accessories:

1. Auxiliary switches for fan control or position indication.
2. Test and reset switches, damper mounted (if accessible), remote mounted (if inaccessible).

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Or approved equivalent.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Hat-shaped, 0.063-inch- thick, galvanized sheet steel, with interlocking, gusseted corners and mounting flange.

F. Heat-Responsive Device: Resettable, 350 deg F rated, fire-closure device.

G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

H. Smoke Detector: Loose for field-installation in ductwork within 5’-0” of damper.

I. Blades: Roll-formed, airfoil, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.

J. Seals: Blade edge seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb shall be constructed of flexible stainless steel compression type seals.

K. Leakage: Class I.

L. Rated pressure and velocity to exceed design airflow conditions.

M. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

N. Damper Motors: Two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for fan control or position indication.
2. Test and reset switches, damper mounted (if accessible), remote mounted (if inaccessible).

2.8 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. McGill AirFlow LLC.
4. Pottorff; a division of PCI Industries, Inc.
5. Ventfabrics, Inc.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
7. Elgen.
8. Or approved equivalent.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Sheet metal, to match duct material, with insulation fill and thickness as indicated for duct pressure class.
c. Hinges and Latches: 2-by-2-inch butt or piano hinge and cam latches.

d. Fabricate doors airtight and suitable for duct pressure class.
e. Size: Not less than 16 inches by 14 inches. Ducts less than 16 inches in height, install with one dimension 16 inches and other dimension 2 inches less than duct width. Install larger sized doors where required for access.

2. Frame: Same material as door, 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 with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.
4. Acudor.
5. Or approved equivalent.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 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. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
5. Or approved equivalent.

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.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 30 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.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 30 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.

2.11 FLEXIBLE DUCTS

A. Manufacturers:

1. Type 6M by Flexmaster U.S.A., Inc.
2. Thermaflex Type MK-E by Flexible Technologies, Inc
3. Hart & Cooley, Inc.
4. McGill AirFlow Corporation.
5. Or approved equivalent.

B. Acoustical Insulated Steel Spiral Type:

1. Comply with SMACNA HVAC Flexible Duct Construction Standards and NFPA 90A.

2. Construct ducts of corrosion-resistant spunbound nylon fabric, mechanically locked to the duct helix without the use of adhesives. Duct helix shall be made of corrosion resistant galvanized steel. Vapor barrier shall be fire retardant, reinforce aluminum.

3. Duct shall be factory-insulated with a fiberglass blanket covered with a flame-resistant low permeability metalized vapor barrier jacket. Thermal conductivity of the insulation shall not exceed 0.23 (BTU) (inch)/(hour) (square foot) (degree F) at 75 degrees F mean temperature.

4. The internal working pressure rating shall be at least 6 inches w.g. positive and 5 inches w.g. negative up to 16” dia.

5. The flexible duct assembly shall carry UL 181, Class 1 air duct label.

6. Maximum length shall be 8 feet or less, as dictated by codes. The remainder shall be galvanized sheet metal. Provide flexible duct runs as straight as possible. Provide a minimum installed length of 5 feet at each air terminal.

C. Flexible Duct Attachment Types:

1. Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.
2. Flexible nylon straps with a minimum 175 pound tensile strength.

2.12 WIRE MESH GRILLES

A. Construction: 1/2 inch (12.5 mm) mesh screen with 1 inch (2.5 mm) sheet metal frame, bolted to flanged duct connection.

B. Materials:

1. Screen: Minimum 18 gauge galvanized steel.
2. Frame: Minimum 0.040 inch (1.02 mm) thick galvanized sheet steel.
3. Bolts and nuts: Indoors, galvanized steel; exposed to weather, stainless steel.

2.13 DUCT ACCESSORY HARDWARE

A. 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.

B. 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 and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Fire, Smoke and Combination Fire and Smoke Dampers:

1. Install dampers in accordance with manufacturer’s UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in

accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.

2. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
3. Install dampers square and free from racking.
4. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
5. Do not compress or stretch the damper frame into the duct or opening.
6. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.
7. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts and as indicated. 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 hat channel.

1. Install volume dampers at the following locations:

   a. Where indicated on drawings and in details.
   b. Where required for balancing.

2. Install steel volume dampers in steel ducts.
3. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated and in ductwork where required for testing and adjusting.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. For Fire Dampers and Combination Fire-Smoke Dampers.
2. For Grease Ducts with applicable Grease Access Doors in accordance with the IMC 2018.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors at duct connections to equipment, at building expansion joints, at connections between ducts of dissimilar metals and at penetrations of mechanical equipment room walls.
1. Install flexible connections with 2 inches slack in fabric and minimum movement of 1 inch.

M. Install duct test holes where required for testing and balancing purposes.

N. Install wire mesh screen grilles at refrigerant exhaust air ducts and in other places where indicated. Bolt grilles to flanged connections or ducts at terminations.

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. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713

DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:

1. Division 8 Section "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.

2. Division 23 Section "Duct Accessories" for fire dampers and volume-control dampers not integral to diffusers, registers, and grilles.

3. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Product Data: For each 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.

3. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

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 DIFFUSER SCHEDULE

A. Square Diffuser <CD>.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Price.
    b. Titus.
    c. Carnes Co. Inc.
    d. Krueger.
    e. Anemostat.
    f. Or approved equal.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Duct Connection: Round or square as required.
5. Face Style: Square, panel. Refer to schedule for types that required adjustable pattern.
6. Mounting: Flush. Nominal 24”x24” Lay in. Plaster frame where required and coordinate final frame with ceiling type.
7. Pattern: 4 way or as indicated on drawings.
8. Accessories: Include the following:
    a. Equalizer deflectors.
    b. Operating keys.

B. Round Diffuser<CD>.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Price.
    b. Titus.
    c. Carnes Co. Inc.
    d. Krueger.
    e. Anemostat.

f. Or approved equal.

2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Duct Connection: Round as required.
5. Face Style: Round, 3-cone.
6. Mounting: Plaster frame or duct mounted as required.
7. Pattern: Fixed.
8. Dampers: Aluminum opposed blade with adjusting screw.
9. Accessories: Include the following:

a. Equalizer deflectors.
b. Operating keys.

2.3 REGISTER or GRILLE SCHEDULE

A. Register or Grille <SR, ER, RR, RG, TG>.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Price.
b. Titus
c. Carnes Co. Inc.
d. Krueger.
e. Anemostat.
f. Or approved equal.

2. Material: Aluminum or Steel; refer to device schedule.
3. Finish: Baked enamel, color as selected by Architect.
4. Face Blade Arrangement: Fixed horizontal.
5. Rear Blade Arrangement: Fixed vertical.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed-blade assembly.
9. Accessories: Include plaster frame as applicable and damper operating key.

B. Specialty Supply Register <SR, SG>:

1. Products:
a. Price.
b. Titus
c. Carnes Co. Inc.
d. Krueger.
e. Anemostat.
f. Or approved equal.

2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Adjustable vertical spaced 3/4 inch apart.
5. Rear Blade Arrangement: Adjustable horizontal spaced 3/4 inch apart.
6. Border: 1-1/4 inches wide.
7. Mounting: Direct spiral duct-mounted.

a. All direct spiral duct-mounted supply grilles shall be constructed with radius end caps and foam gaskets for a tight seal to the duct diameter.

8. Damper Type: Aluminum, adjustable by screw, air scoop damper/extractor.
9. Damper Type: Adjustable opposed-blade assembly.

2.4 LINEAR SLOT DIFFUSER

A. Linear Slot Diffuser

1. Products: Subject to compliance with requirements, provide one of the following:

a. Price.
b. Titus.
c. Carnes Co. Inc.
d. Krueger.
e. Anemostat.
f. Or approved equal.

2. Material: Extruded Aluminum
3. Finish: Baked enamel, color as selected by Architect.
4. Frame: Heavy duct extruded aluminum
5. Slots: Refer to device schedule for number and width.
6. Adjustable pattern damper.
7. Insulated sheet metal boot and plenum.

2.5 LINEAR JET-SLOT DIFFUSER

A. Linear Slot Diffuser

1. Products: Subject to compliance with requirements, provide one of the following:

a. Price.
b. Titus.
c. Carnes Co. Inc.
d. Krueger.
e. Anemostat.
f. Or approved equal.

2. Material: Extruded Aluminum
3. Finish: Baked enamel, color as selected by Architect.
4. Frame: Heavy duct extruded aluminum.
5. Slots: Refer to device schedule for number and width.
6. Adjustable pattern damper.
7. Insulated sheet metal boot and plenum.

2.6 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, registers, 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, registers, 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 practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. It is the responsibility of the contractor to review architectural drawings and provide applicable mounting frame for type of surface or ceiling indicated on architectural drawings. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, 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.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes. Final cleaning is by the General Contractor.

END OF SECTION 233713

SECTION 237414 - PACKAGED, OUTDOOR ROOFTOP UNITS

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 packaged, outdoor, rooftop units in the following configurations:

1. Electric Cooling and Gas Heating packaged rooftop unit.

B. This Section also includes required accessories to be included with the packaged, outdoor, rooftop units such as:

1. Direct-expansion cooling.
2. Hot-gas reheat.
3. Supply/Exhaust Fans
4. Gas furnace.
5. Economizer outdoor- and return-air damper section.
   a. Field-or-factory mounted.
6. Integral, space temperature controls.
7. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with wind and seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of New Jersey, using performance requirements and design criteria indicated in Section 230548.

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports 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. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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 test reports.

D. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: One set of filters for each unit.

1.9 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 WARRANTY

A. Manufacturer's standard warranty for packaged outdoor air-handling unit and controls for eighteen (18) months from date of shipment. Warranty work shall be performed by manufacturer's factory-trained and factory-employed technician. Warranty does not extend to alterations, modifications, or external components installed after unit is shipped.

1.11 SPECIAL WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fails in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Daikin.
2. Trane.
3. Aaon.
4. Or approved equivalent.

2.2 CABINET, CASING AND FRAME

A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

B. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16" at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.

C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.3 OUTDOOR / RETURN AIR SECTION

A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges.

B. Provide factory installed and tested, outdoor air monitor that controls outdoor air +/- 15% accuracy down to 40 cfm per ton.

C. Daikin Applied UltraSeal low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a factory installed actuator.

D. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

2.4 EXHAUST FAN

A. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

C. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

2.5 FILTERS

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2” prefilter and a 4” final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2” MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.6 COOLING COIL

A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond

the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

2.7 HOT GAS REHEAT

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

D. Each coil shall be factory leak tested with high-pressure air under water.

2.8 SUPPYL FAN

A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additonal maintenance.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

C. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.9 VARIABLE AIR VOLUME CONTROL

A. The unit controller shall proportionally control the ECM motors on the supply fan based on space temperature or unit discharge air temperature based on programmed sequence. The unit

controller shall increase/decrease the speed of the supply fan in order to maintain the space or discharge temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with the compressor modulation range.

2.10 GAS FURNACE HEATING

A. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.

B. The module shall be complete with furnace controller and control valve capable of 5:1 modulating operation.

C. The heat exchanger tubes shall be constructed of stainless steel.

D. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

E. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

F. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

2.11 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

C. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

D. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

E. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

F. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

G. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.12 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.13 CONTROLS

A. Packaged, outdoor rooftop units shall be supplied with a unit-mounted, factory installed unitary controller utilizing “open” control language protocol; BACnet protocol. The controller shall perform all functions as described in Section 230993 “Sequence of Operations for HVAC Controls.” The DDC controller shall have volatile memory backup and have the required connections to perform control and monitoring of safeties as noted within Section 230993 “Sequence of Operations for HVAC Controls.”

B. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

C. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain

existing set points and operate stand-alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

D. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

E. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

F. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to ensure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

G. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

1. Return air temperature.
2. Discharge air temperature.
3. Outdoor air temperature.
4. Space air temperature.
5. Outdoor enthalpy, high/low.
6. Compressor suction temperature and pressure
7. Compressor head pressure and temperature
8. Expansion valve position
9. Condenser fan speed
10. Inverter compressor speed
11. Dirty filter indication.
12. Airflow verification.
13. Cooling status.
14. Control temperature (Changeover).
15. VAV box output status.
16. Cooling status/capacity.
17. Unit status.
18. All time schedules.
19. Active alarms with time and date.
20. Previous alarms with time and date.
21. Optimal start
22. Supply fan and exhaust fan speed.
23. System operating hours.
    a. Fan

b. Exhaust fan
c. Cooling
d. Individual compressor
e. Heating
f. Economizer
g. Tenant override

H. The user interaction with the keypad shall provide the following:

1. Controls mode
   a. Off manual
   b. Auto
   c. Heat/Cool
   d. Cool only
   e. Heat only
   f. Fan only
2. Occupancy mode
   a. Auto
   b. Occupied
   c. Unoccupied
   d. Tenant override
3. Unit operation changeover control
   a. Return air temperature
   b. Space temperature
   c. Network signal
4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
   a. Return air temperature
   b. Outdoor air temperature
   c. Space temperature
   d. Airflow (VAV)
   e. Network signal
   f. External (0-10 vdc)
   g. External (0-20 mA)
7. Temperature alarm limits
   a. High supply air temperature
   b. Low supply air temperature
   c. High return air temperature
8. Lockout control for compressors.
9. Compressor interstage timers
10. Night setback and setup space temperature.
11. Building static pressure.
12. Economizer changeover
    a. Enthalpy
    b. Drybulb temperature
13. Currently time and date
14. Tenant override time
15. Occupied/unoccupied time schedule
16. One event schedule
17. Holiday dates and duration
18. Adjustable set points

19. Service mode
    a. Timers normal (all time delays normal)
    b. Timers fast (all time delays 20 sec)
20. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
    a. Zone sensor with tenant override switch
    b. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)
21. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
    a. Airflow
    b. Outside air temperature
    c. Space temperature
    d. Return air temperature
    e. External signal of 1-5 vdc
    f. External signal of 0-20 mA
    g. Network signal

2.14 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet, non-powered.

B. Return-Air Smoke Detector: Provide smoke detector sensing in the return-air section for all equipment with supply air quantities equaling 2,000 CFM or greater.

C. Low Temperature Thermostat.

D. Discharge Air Temperature Sensor.

E. Motorized Outside Air Damper.

F. Coated Coils.

G. Hail guards.

H. Through the base provisions for the following (unless indicated as being routed through unit exterior on contract drawings): Electrical power and natural gas piping.

I. Clogged Filter/Fan Failure Switch: Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

J. Economizer: Provide fully modulating 0-100 percent motor and dampers, minimum position setting, preset linkage, wiring harness with plug, spring return actuator and comparative enthalpy control. The unit shall be provided with barometric relief.

    1. For economizer sections that cannot be physically factory installed or bolted on to available openings on factory units, manufacturer shall provide economizer section with

barometric relief to be duct-mounted into return-air ductwork in field by the Contractor. Basis of Design: MicroMetl or approved equal. Power and control for duct-mounted economizer shall come from the air-handling unit.

2.15 ROOF CURBS AND ROOF CURB ADAPTERS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 14 inches minimum.

C. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

2.16 CAPACITIES AND CHARACTERISTICS

A. Refer to contract drawings for capacities and characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Equipment Mounting:

1. Install packaged, outdoor rooftop units on existing roof curbs or existing structure as indicated on contract drawings. Provide roof curb adapter as required to provide re-use of existing roof curb with the installation of the new unit and to minimize disturbance of existing roofing system.

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.

c. Outdoor-air, dry-bulb temperature.
d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

26. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 237413

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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

1. Belden Inc.

2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 ASTM B 496 for stranded conductors.

E. Conductor Insulation:

1. Type USE-2 and Type SE: Comply with UL 854.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

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

1. Belden Inc.
2. Encore Wire Corporation.
3. General Cable Technologies Corporation.
4. Okonite Company (The).
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors Aluminum, complying with ASTM B 800 and ASTM B 801.

F. Ground Conductor: Bare & Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

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

1. 3M Electrical Products.
2. Hubbell Power Systems, Inc.
3. Ideal Industries, Inc.
4. ILSCO.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: Two hole with long barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

a. Test wells.
b. Ground rods.
c. Ground rings.
d. Grounding arrangements and connections for separately derived systems.

2. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NFPA 70B.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

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.

2.2 MANUFACTURERS

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

1. Advanced Lightning Technology, Ltd.
2. Burndy; Part of Hubbell Electrical Systems.
3. ERICO; a brand of nVent.
4. Harger Lightning & Grounding.
5. ILSCO.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Robbins Lightning, Inc.
8. Siemens Industry, Inc., Energy Management Division.
9. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches by 18 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

H. Conduit Hubs: Mechanical type, terminal with threaded hub.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

N. Straps: Solid copper, copper lugs. Rated for 600 A.

O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.

P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

Q. Water Pipe Clamps:

1. Mechanical type, two pieces with zinc-plated bolts.

a. Material: Tin-plated aluminum.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. 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.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

E. EQUIPMENT GROUNDING

F. Install insulated equipment grounding conductors with all feeders and branch circuits.

G. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.

7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

H. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

I. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

J. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

F. See the Evaluations for discussion on appropriate ground-resistance values. Typical maximum permitted values are listed below for different grounding applications; retain applicable

subparagraphs and revise to suit Project. Coordinate with requirements in Sections specifying equipment to be grounded.

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 and above kVA: 5 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

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

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
2. Component Importance Factor: 1.0.

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 Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

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

a. B-line, an Eaton business.
b. Thomas & Betts Corporation; A Member of the ABB Group.
c. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

        1) Hilti, Inc.
        2) MKT Fastening, LLC.
        3) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

        1) B-line, an Eaton business.
        2) Hilti, Inc.
        3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58,Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

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

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

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.
    f. FSR Inc.
    g. Korkap.
    h. NEC, Inc.
    i. Opti-Com Manufacturing Network, Inc (OMNI).
    j. O-Z/Gedney; a brand of Emerson Industrial Automation.
    k. Patriot Aluminum Products, LLC.
    l. Perma-Cote.

2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.
4. ARC: Comply with ANSI C80.5 and UL 6A.
5. IMC: Comply with ANSI C80.6 and UL 1242.
6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.

7. EMT: Comply with ANSI C80.3 and UL 797.
8. FMC: Comply with UL 1; aluminum.
9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

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

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.

f. FSR Inc.
g. Korkap.
h. NEC, Inc.
i. NewBasis.
j. Opti-Com Manufacturing Network, Inc (OMNI).
k. O-Z/Gedney; a brand of Emerson Industrial Automation.
l. Patriot Aluminum Products, LLC.
m. Perma-Cote.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:

a. Material: Steel.
b. Type: compression.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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

a. AFC Cable Systems; a part of Atkore International.
b. CANTEX INC.
c. Condux International, Inc.
d. Kraloy.
e. RACO; Hubbell.
f. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.

2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

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

   a. CANTEX INC.
   b. Condux International, Inc.
   c. Kraloy.
   d. RACO; Hubbell.
   e. Thomas & Betts Corporation; A Member of the ABB Group.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.

3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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. B-line, an Eaton business.
2. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

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. Allied Moulded Products, Inc.
2. Hoffman; a brand of nVent.
3. Lamson & Sessions.
4. Niedax Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 BOXES, ENCLOSURES, AND CABINETS

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. Crouse-Hinds, an Eaton business.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman; a brand of nVent.
5. Hubbell Incorporated.
6. Hubbell Incorporated; Wiring Device-Kellems.
7. Milbank Manufacturing Co.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Semi-adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: 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, rectangular.

1. Listing and Labeling: 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. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R 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: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1 Type 3R 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.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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

    a. Armorcast Products Company.
    b. NewBasis.
    c. Oldcastle Enclosure Solutions.
    d. Oldcastle Precast, Inc.
    e. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

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

    a. Armorcast Products Company.
    b. NewBasis.
    c. Nordic Fiberglass, Inc.
    d. Oldcastle Enclosure Solutions.
    e. Oldcastle Enclosure Solutions.
    f. Oldcastle Precast, Inc.
    g. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical & Electrical rooms.
    d. Barns, Stables, maintenance buildings and other similar buildings.
    e. Band Shell.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. 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 compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch 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 ENT to GRC or IMC before rising above floor.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

Q. Install devices to seal raceway 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 raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
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 temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F 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 degree F of temperature change for PVC 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.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. 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 center of box unless otherwise indicated.

U. 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 surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

W. Locate boxes so that cover or plate will not span different building finishes.

X. 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.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12

inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, 36” below grade.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 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. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
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.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available 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. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.
    e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 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:

    a. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 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.

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

3.1 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 raceway 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 raceway 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 raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel 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 raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

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

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White.
6. Color for Equipment Grounds: Bare copper, Green, or Green with a yellow stripe.
7. Colors for Isolated Grounds: Green with white stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.
e. Switchboards.
f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Enclosed switches.
j. Enclosed circuit breakers.
k. Enclosed controllers.
l. Variable-speed controllers.
m. Push-button stations.
n. Power transfer equipment.
o. Contactors.
p. Remote-controlled switches, dimmer modules, and control devices.
q. Battery racks.
r. Power-generating units.
s. Monitoring and control equipment.
t. UPS equipment.
u. BMS Server.
v. Lighting Control System equipment.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

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

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. LEM Products Inc.
g. Marking Services, Inc.

h. Panduit Corp.
i. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

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

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.

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

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. Grafoplast Wire Markers.
e. Ideal Industries, Inc.
f. LEM Products Inc.
g. Marking Services, Inc.
h. Panduit Corp.
i. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

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

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.

d. emedco.
e. Grafoplast Wire Markers.
f. HellermannTyton.
g. Ideal Industries, Inc.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Panduit Corp.
k. Seton Identification Products.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inchesfor raceway and conductors.
b. 3-1/2 by 5 inchesfor equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.

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

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

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

a. Brady Corporation.
b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

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

a. Carlton Industries, LP.
b. Champion America.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

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

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

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

a. HellermannTyton.
b. LEM Products Inc.
c. Marking Services, Inc.
d. Seton Identification Products.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

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

a. Carlton Industries, LP.
b. Seton Identification Products.

E. Underground-Line Warning Tape:

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

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products Inc.
d. Marking Services, Inc.

e. Reef Industries, Inc.
f. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag: Type I:

a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Thickness: 4 mils.
d. Weight: 18.5 lb/1000 sq. ft..
e. Tensile according to ASTM D 882: 30 lbf and 2500 psi.

5. Tag: Type ID:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft..
f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Write-on Tags:

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

    a. Carlton Industries, LP.
    b. LEM Products Inc.
    c. Seton Identification Products.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

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

    a. Carlton Industries, LP.
    b. Champion America.
    c. emedco.
    d. Marking Services, Inc.

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.

3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

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

    a. Brady Corporation.
    b. Champion America.
    c. emedco.
    d. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.

3. 1/4-inch grommets in corners for mounting.

4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

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

   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.

2. Engraved legend.

3. Thickness:

   a. For signs up to 20 sq. in., minimum 1/16 inch thick.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Self-adhesive.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer and load shedding.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

N. Vinyl Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 15A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "NORMAL POWER."
3. "UPS."
4. “LIFE SAFETY EMERGENCY POWER”.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labelswith the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Self-adhesive labels.

P. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer and load shedding.

Q. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching and dimming controls.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy and vacancy sensors
6. Digital timer light switches.
7. High-bay occupancy and vacancy sensors.
8. Outdoor motion sensors.
9. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

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. Lutron Controls.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST, DPST or DPDT as required.
3. Contact Rating: 30-A inductive or resistive, 600-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
6. Programs: 12 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
7. Programs: 12 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.
8. Programs: 12 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
9. Programs: 12 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
10. Programs: 12 channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program and an annual holiday schedule that overrides the weekly operation on holidays.
11. Programs: 6 and an annual holiday schedule that overrides the weekly operation on holidays.

12. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
13. Astronomic Time: All channels.
14. Automatic daylight savings time changeover.
15. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

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. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

B. Description: Solid state, with SPST or DPST dry contacts as required rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

C. Description: Solid state; one set of NO dry contacts rated for 24 V ac at 1 A, to operate connected load, complying with UL 773, and compatible with luminaire and lighting control panelboard.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Mounting: 1/2-inch threaded male conduit.
5. Failure Mode: Luminaire stays ON.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

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. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Intermatic, Inc.
5. Leviton Manufacturing Co., Inc.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC.
9. Philips Lighting Controls.
10. RAB Lighting.
11. Sensor Switch, Inc.
12. Square D.
13. WattStopper; a Legrand® Group brand.

B. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared & Ultrasonic technology.
3. Separate power pack.
4. Wireless connection to switch; and BAS and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A Wireless.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 3000 square feet when mounted 48 inches above finished floor.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 3000 square feet when mounted 84 inches above finished floor.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 3000 square feet when mounted 48 inches above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
4. Intermatic, Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. Lutron Electronics Co., Inc.
7. Schneider Electric USA (Square D).

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection or using wireless connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type:dual circuit.
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage - 120 and 277 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: Black.
11. Faceplate: Color matched to switch.

D. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: PIR.
3. Switch Type: SP, manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage, 120 and 277 V.

6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: Black.
11. Faceplate: Color matched to switch.

2.5 DIGITAL TIMER LIGHT SWITCH

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. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10-20 minute increments.

1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
2. Integral relay for connection to BAS.
3. VoltageDual voltage - 120 and 277 V.
4. Color: Black
5. Faceplate: Color matched to switch.

2.6 OUTDOOR MOTION SENSORS

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. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. RAB Lighting.

B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Dual-technology (PIR and infrared) type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
3. Switch Rating:

    a. Luminaire-Mounted Sensor:500-VA LED.
    b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

4. Switch Type: SP, manual "on," automatic "off."
5. Voltage: Dual voltage, 120- and 277-V type.
6. Detector Coverage:

    a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
    b. Long Range: 180-degree field of view and 110-foot detection range.

7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.7 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO: a brand of Vertiv.
3. Eaton.
4. Schneider Electric USA (Square D).

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. SPD receptacles.
5. Toggle switches.
6. Decorator-style convenience.
7. Wall switch sensor light switches with dual technology sensors.
8. Wall switch sensor light switches with passive infrared sensors.
9. Wall switch sensor light switches with ultrasonic sensors.
10. Digital timer light switches.
11. Residential devices.
12. Wall-box dimmers.
13. Wall plates.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.3 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 12 V, 2.0 A, USB Type A; Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.
1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, Type A.
3. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.4 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

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

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Pass & Seymour/Legrand (Pass & Seymour).

2.5 SPD RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.

1. 125 V, 20 A, straight blade type.
2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex SPD Convenience Receptacles:

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

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.

C. Isolated-Ground Duplex SPD Convenience Receptacles:

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

    a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description:

a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Pilot-Light Switches, 120/277 V, 20 A:

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

2.6 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches: Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

G. Lighted Toggle Switches: Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: With LED-lighted handle, illuminated when switch is off.

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail,or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Tests for Convenience Receptacles:

a. Line Voltage: Acceptable range is 105 to 132 V.
b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
c. Ground Impedance: Values of up to 2 ohms are acceptable.
d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
e. Using the test plug, verify that the device and its outlet box are securely mounted.
f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 004519 - AFFIDAVIT OF NON-COLLUSION

Name of Project: WIND SAFETY TRAINING CENTER
ATLANTIC CITY CAMPUS
Atlantic Cape Community College

I, _____ (Name) of the County of _____ (County)

and the State of_____(State), of full age, being duly sworn according to law, on my oath, depose and say that:

I am _____ (Official Position)

of the firm of _____ (Bidder's Name),

the bidder making the Proposal for the above-named project, and that I executed the said Proposal with full authority to do so.

I, and to the best of my knowledge, the Bidder, and any officer, director, employee or other representative of the bidder, have not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above named project.

All statements contained in said Bid and all Contract Documents and in this affidavit are true and correct, and made with full knowledge that the Board of Trustees of Atlantic Cape Community College relies upon the truth of the statements contained in said Bid and contract documents and in the statements contained in this affidavit in awarding the contract for the said project.

Sworn on behalf of:

_____
Name of Firm (Bidder)

_____
Signature of Official

Subscribed and sworn to me this

_____ day of _____,20____

_____ (name) (Seal)

Notary Public of: _____
(State)

EXHIBIT B: N.J.S.A. 10.5-31 et seq. (P.L. 1975, c127) N.J.A.C. 17:27-1.1 et seq.

MANDATORY EQUAL OPPORTUNITY LANGUAGE: CONSTRUCTION CONTRACTS

During the performance of this contract, the contractor agrees as follows:

a. The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex. Except with respect to affectional or sexual orientation and gender identity or expression , the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

b. The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex;

c. The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to **N.J.S.A. 10:5-31 et seq.**, as amended and supplemented from time to time and the Americans with Disabilities Act.

e. When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by **N.J.A.C. 17:27-7.2**; provided, however, that the Department of LWD, Construction EEO Monitoring Program, may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Department of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Department of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with **N.J.S.A. 17:27-7.2**. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to **N.J.S.A. 10:5-31 et seq**., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union, at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities, as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(1) To notify the Public Agency Compliance Officer, the Department of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to **N.J.A.C. 17:27-5.3,** of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this regulation, as well as the applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(i) The contractor or subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set

forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Department of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Department of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the Public Agency Compliance Officer and to the Department of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Department of LWD, Construction EEO Monitoring Program and submitted promptly to the Department of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the Public Agency Compliance Officer and the Department of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA 201) electronically provided to the public agency by the Division, through its website, for distribution to and completion by the contractor, in accordance with **N.J.A.C. 17:27-7.** The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Department of LWD, Construction EEO Monitoring Program and to the Public Agency Compliance Officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for the on-the-job and/or off-the-job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Department of LWD, Construction EEO Monitoring Program as may be requested by the Department of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Department of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to **Subchapter 10 of the Administrative Code at N.J.A.C. 17:27**.

_____	_____	_____
Authorized Signature	Name of Firm	Date

BIDDER'S CERTIFICATION REGARDING DEBARMENT/DISQUALIFICATION/SUSPENSION

INSTRUCTIONS FOR CONTRACTOR CERTIFICATION REGARDING THE QUALIFICATION, DEBARMENT, SUSPENSION, AND DISQUALIFICATION OF PERSON(S) COVERING CONTRACT ADMINISTRATION

1. By signing and submitting Contractor Certification 004541-(3), the Contracting Firm is bound by the representations of this certification.

2. The Certification is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the Contracting Firm knowingly rendered an erroneous Certification, in addition to other remedies available to the Owner, the Owner may pursue available remedies, including qualification, suspension, disqualification and/or debarment.

3. The Contracting Firm shall provide immediate written notice to the Owner if at any time it learns that its Certification was erroneous by reason of changed circumstances.

4. The terms "debarment", "disqualification", "qualification" and "suspension", as used in this clause, have the meanings as defined in N.J.A.C.7:19-1-1 et seq.. You may contact the Atlantic Cape Community College for assistance in obtaining a copy of those regulations.

5. The Contracting Firm further agrees by submitting this Certification that it will include the clause titled "Certification Regarding Qualification, Debarment, Suspension and Disqualification of person(s) concerning Contract Administration," without modification, in all subcontracts to this agreement as authorized by the Owner.

BIDDER'S CERTIFICATION REGARDING DEBARMENT/DISQUALIFICATION/SUSPENSION

CERTIFICATION REGARDING THE QUALIFICATION, DEBARMENT, SUSPENSION AND DISQUALIFICATION OF PERSON(S) CONCERNING CONTRACT ADMINISTRATION

****

I am _____ (Bidder or an Officer or Partner of the Bidder,

and indicate which) of the Firm of _____
(Name of Your Organization)

_____.
(State the Address of Your Organization)

CHOOSE ONE OF THE FOLLOWING
****

( ) A. I hereby certify on behalf of _____
(Name of Your Organization)

that, on the date and time of the bid, neither it nor its principals is/are included on the State Treasurer's, or the Federal Government's List of Debarred, Suspended or Disqualified Bidders as a result of action taken by any State or Federal Agency. If awarded the contract, the Bidder acknowledges and agrees to insert into all its contracts with all Subcontractors and Subconsultants a clause stating that the Contracted Party, its Subcontractors or Subconsultants may be debarred, suspended or disqualified from contracting and/or working on the School Facilities Project if found to have committed any of the acts listed in N.J.A.C. 19:38A-4.1 et seq.

( ) B. I am unable to certify to any of the statements set forth in this Certification. I have attached an explanation to this form.

_____
(Signature)

_____
(Typed Name and Title)

_____
(Date)

Sworn and subscribed before me this

_____ day of _____ 20___.

NOTARY PUBLIC _____
(Signature)

_____
(Print Name)

SEAL

Notary Public - State of _____

My Commission Expires _____

ATLANTIC CAPE COMMUNITY COLLEGE CONSENT OF SURETY

A performance bond will be required from the successful bidder, including all subcontractors, on this project as N.J.S.A. 18A:64A-25.25 requires, and consequently, all bidders/vendors, including all subcontractors, shall submit, with their bid, a consent of surety in substantially the following form:

To: _____
(Owner – Atlantic Cape Community College)

Re: _____
(Bidder/Vendor)

_____
(Project Description)

This is to certify that the _____ will provide to
(Surety Company)

_____ a performance bond in the full amount of the awarded contract in
(Owner)
the event that said vendor is awarded a contract for the above project.

_____
(Bidder/Vendor)

_____
(Authorized Agent of Surety Company)

Date: _____

CONSENT OF SURETY MUST BE SIGNED BY AN AUTHORIZED AGENT OR REPRESENTATIVE OF A SURETY COMPANY AND NOT BY THE INDIVIDUAL OR COMPANY REPRESENTATIVE SUBMITTING THE BID.

THE CONTRACTOR MAY PROVIDE BONDING ON BEHALF OF THE SUBCONTRACTORS.

CERTIFICATION TO DEMONSTRATE THE CONTRACTOR'S ABILITY TO PERFORM THE WORK WITH THE NECESSARY EQUIPMENT REQUIRED

****

I am _____ (an Owner, a Partner, or an Officer of the Company or Corporation and indicate which) of the Firm

_____

(Name of the Firm)

_____.

(State the Address of the Firm)

CHOOSE ONE OF THE FOLLOWING

****

( ) A. I hereby certify on behalf of _____

(Name of the Firm)

that we are the actual Owner, Lessee or control all equipment necessary to perform the work of this Project.

( ) B. I hereby certify on behalf of _____

(Name of the Firm)

that we are not the actual Owner or Lessee of the equipment necessary to perform the work of this Project. The source from which the equipment will be obtained is as follows: (Provide Names, Addresses and Telephone Numbers)

_____

_____

_____

_____

NOTE: Should additional Names, Addresses and Telephone Numbers be required, please list them on a separate sheet and attach to this document.

Certificates from the Owner or Person in control of the equipment clearly granting our Firm the control of the equipment required for such time as may be required to perform the work of this Project are included and attached to this Certification.

_____
(Signature)

_____
(Typed Name and Title)

_____
(Date)

CERTIFICATION OF NON-DEBARMENT
FOR FEDERAL GOVERNMENT CONTRACTS

N.J.S.A. 52:32-44.1 (P.L. 2019, c.406)

This certification shall be completed, certified to, and submitted to the contracting unit prior to contract award, except for emergency contracts where submission is required prior to payment.

PART I: VENDOR INFORMATION	
Individual or Organization Name	
Address of Individual or Organization	
DUNS Code (if applicable)	
CAGE Code (if applicable)	
Check the box that represents the type of business organization:	

☐Sole Proprietorship (skip Parts III and IV) ☐Non-Profit Corporation (skip Parts III and IV)

☐For-Profit Corporation (any type) ☐Limited Liability Company (LLC) ☐Partnership

☐Limited Partnership ☐Limited Liability Partnership (LLP)

☐Other (be specific): _____

PART II – CERTIFICATION OF NON-DEBARMENT: Individual or Organization			
I hereby certify that the **individual or organization listed above in Part I** is not debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***<name of contracting unit>*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by ***<type of contracting unit>*** to notify the ***<type of contracting unit>*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***<type of contracting unit>***, permitting the ***<type of contracting unit>*** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

PART III – CERTIFICATION OF NON-DEBARMENT: Individual or Entity Owning Greater than 50 Percent of Organization

CERTIFICATION OF NON-DEBARMENT
FOR FEDERAL GOVERNMENT CONTRACTS

Section A (Check the Box that applies)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of its voting stock, or of the partner in the partnership who owns more than 50 percent interest therein, or of the member of the limited liability company owning more than 50 percent interest therein, as the case may be.
Name of Individual or Organization	
Home Address (for Individual) or Business Address	
OR	
☐	No one stockholder in the corporation owns more than 50 percent of its voting stock, or no partner in the partnership owns more than 50 percent interest therein, or no member in the limited liability company owns more than 50 percent interest therein, as the case may be.
Section B (Skip if no Business entity is listed in Section A above)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of the voting stock of the organization's parent entity, or of the partner in the partnership who owns more than 50 percent interest in the organization's parent entity, or of the member of the limited liability company owning more than 50 percent interest in organization's parent entity, as the case may be.
Stockholder/Partner/Member Owning Greater Than 50 Percent of Parent Entity	
Home Address (for Individual) or Business Address	
OR	
☐	No one stockholder in the parent entity corporation owns more than 50 percent of its voting stock, no partner in the parent entity partnership owns more than 50 percent interest therein, or no member in the parent entity limited liability company owns more than 50 percent interest therein, as the case may be.
Section C – Part III Certification	
I hereby certify that no individual or organization that is debarred by the federal government from contracting with a federal agency owns greater than 50 percent of the **Organization listed above in Part I** or, if applicable, owns greater than 50 percent of a parent entity of **<name of organization>**. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***<name of contracting unit>*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award ***<type of***	

contracting unit> to notify the ***<type of contracting unit>*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***<type of contracting unit>***, permitting the ***<type of contracting unit>*** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

Part IV – CERTIFICATION OF NON-DEBARMENT: Contractor – Controlled Entities		
Section A		
☐	Below is the name and address of the corporation(s) in which the **Organization listed in Part I** owns more than 50 percent of voting stock, or of the partnership(s) in which the **Organization listed in Part I** owns more than 50 percent interest therein, or of the limited liability company or companies in which the **Organization listed above in Part I** owns more than 50 percent interest therein, as the case may be.	
Name of Business Entity		**Business Address**
Add additional sheets if necessary		
OR		
☐	The **Organization listed above in Part I** does not own greater than 50 percent of the voting stock in any corporation and does not own greater than 50 percent interest in any partnership or any limited liability company.	

Section B (skip if no business entities are listed in Section A of Part IV)	
☐	Below are the names and addresses of any entities in which an entity listed in Part III A owns greater than 50 percent of the voting stock (corporation) or owns greater than 50 percent interest (partnership or limited liability company).

Name of Business Entity Controlled by Entity Listed in Section A of Part IV	Business Address

Add additional Sheets if necessary

OR

☐	No entity listed in Part III A owns greater than 50 percent of the voting stock in any corporation or owns greater than 50 percent interest in any partnership or limited liability company.

Section C – Part IV Certification

I hereby certify that the **Organization listed above in Part I** does not own greater than 50 percent of any entity that that is debarred by the federal government from contracting with a federal agency and, if applicable, does not own greater than 50 percent of any entity that in turns owns greater than 50 percent of any entity debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the ***<name of contracting unit>*** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by ***<type of contracting unit>*** to notify the ***<type of contracting unit>*** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the ***<type of contracting unit>,*** permitting the ***<type of contracting unit>*** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

SECTION 004313 - FORM OF BID BOND

WE, THE UNDERSIGNED_____, a/an

☐ Corporation

☐ Partnership (check applicable term)

☐ Individual

as Principal and_____, as Surety, are held firmly bound unto Atlantic Cape Community College, as Owner, in the penal sum of $ _____, for the payment of which we hereby jointly and severally bid ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE ABOVE OBLIGATION is such that whereas the Principal has submitted to Atlantic Cape Community College a certain Bid, attached hereto and hereby made apart hereof, to enter into a contract in writing, for the:

WIND SAFETY TRAINING CENTER
AT THE
ATLANTIC CITY CAMPUS
Atlantic Cape Community College
Atlantic City, New Jersey 08401

NOW THEREFORE,

(a) If said Bid shall be rejected, or in the alternate,

(b) If said Bid shall be accepted and the Principal shall execute and deliver a contract, properly completed in accordance with said Bid, and shall furnish a bond for the faithful performance of said contract and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid,

then this obligation shall be void; otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunder set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by the proper officers, this

_____day of _____, 20_____.

(continued on next page)

ATTEST:

Principal: _____ (L.S.)

Surety: _____ By: _____

STATE OF)
: SS:
COUNTY OF)

On this _____ day of _____ 20 ___, before me personally came

_____ to me known, who, being by me duly sworn, did dispose and say;

he resides in _____ that he is the _____

of the instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

(SEAL)

_____

Notary Public of _____

My Commission expires _____

FORM OF MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS, That we,

_____

as Principal and

_____

as Surety, are held and firmly bound unto the ATLANTIC CAPE COMMUNITY COLLEGE, as Owner, in the amount of ONE HUNDRED PERCENT (100%) OF THE CONTRACT SUM.

_____

($_____)
(100% of the Contract)

for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas, the Principal did on _____, _____, 20____, enter into a Contract for:

WIND SAFETY TRAINING CENTER
ATLANTIC CITY CAMPUS

FOR THE

ATLANTIC CAPE COMMUNITY COLLEGE
5100 BLACK HORSE PIKE
MAYS LANDING, NEW JERSEY, 08330

WHICH said Contract is made a part of this Bond as though set forth herein: NOW, if the said Principal shall remedy without cost to the Owner any defects which may develop during a period of Two (2) years from the date established in the Final Certificate of Substantial Completion for the work performed under the said Contract, provided such defects, in the judgment of the Owner are caused by defective or inferior materials or workmanship.

The said Surety hereby stipulates and agrees that no modification, deletions or additions in or to the terms of the said Contract or the Drawings or Project Manual therefore shall in any way affect its obligation on this Bond.

(continued on next page)

IN WITNESS WHEREOF, the said Principal and Surety have duly executed this bond under seal this

_____ day of _____, 20___.

ATTEST:

_____
(Principal)

_____
(Principal) Secretary

(SEAL)

BY: _____ (S)

_____

_____
(Address-Zip Code)

_____
(Witness as to Principal)

_____

_____
(Address-Zip Code)

ATTEST:

_____
(Surety)

BY:_____
(Attorney-in-fact)

_____

_____
(Address - Zip Code)

_____
(Surety) Secretary

(SEAL)

_____
(Witness as to Surety)

_____

_____
(Address-Zip Code)

FORM OF PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENT: That

wc/I _____
(Name of Contractor)

A _____
(Corporation, Partnership or Individual)

hereinafter called "Principal", and _____,
(Surety)

of _____ State of _____,

hereinafter called the "Surety", are held and firmly bound unto the ATLANTIC CAPE COMMUNITY COLLEGE, Mays Landing, Atlantic County, New Jersey, hereinafter called "Owner", in the penal sum of

_____Dollars
(Written Amount)

($ _____).
(Figures)

in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally to the Owner, firmly by these presents for the performance of the Construction Contract which is incorporated herein by reference and to pay for all labor, materials and equipment furnished for use in the performance of said Construction Contract.

THE CONDITION OF THIS OBLIGATION IS such that Whereas the Principal entered into a certain contract with the Owner, dated the _____ day of _____, 20_____, a copy of which is hereto attached and made a part hereof for the construction of all work under Contract covering work for:

WIND SAFETY TRAINING CENTER
AT THE
ATLANTIC CITY CAMPUS

FOR THE

ATLANTIC CAPE COMMUNITY COLLEGE
5100 BLACK HORSE PIKE
MAYS LANDING, NEW JERSEY, 08330

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties all the undertakings, covenants, terms, conditions and agreements of said Contract including the payment for labor, materials and equipment furnished for use in the performance of said contract. During the original term thereof, and any extensions thereof which may be granted by the Owner, with or without notice to the Surety, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that by accepting this obligation to ensure the faithful performance and proper fulfillment of the Contract, the Bonding Company agrees to assume all costs required to furnish additional manpower, materials, facilities, equipment, means and incidentals necessary, including night shifts, overtime operations, Sundays and holidays as may be necessary to insure the prosecution and completion of the work in accordance with phased substantial completion dates established in the Contract. The Bonding Company further agrees to reimburse and repay the Owner for all reasonable attorney's fees, additional consequential Architectural, Engineering fees incurred by the Owner for consequential losses or damages including, but not limited to, additional design work, submittal reviews, correspondence, job meetings, reviewing applications for payment, punch lists and similar services by reason of Contractor's default.

PROVIDED, FURTHER, that the Surety, for value received hereby stipulates and agrees that no change, extension of time, alterations or additions to the terms of the Contract or to the work to be performed thereunder or the Project Manual accompanying the same shall in any way affect its obligation on this Bond, and it does hereby waive notice of any change, extension of time, alterations or additions to the terms of the Contract or to the work or to the Project Manual.

PROVIDE FURTHER, that no final settlement between the Owner and Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20____.

ATTEST:

_____
(Principal)

_____
(Principal) Secretary

(SEAL)

BY: _____ (S)

_____

_____
(Address-Zip Code)

_____
(Witness as to Principal)

_____

_____
(Address-Zip Code)

ATTEST:

_____
(Surety)

BY:_____
(Attorney-in-fact)

_____

_____
(Address - Zip Code)

_____
(Surety) Secretary

(SEAL)

_____
(Witness as to Surety)

_____

_____
(Address-Zip Code)

NOTE: Date of Bond must be prior to date of Contract. If Contractor is a Partnership, all partners should execute Bond.

The rate of premium on this Bond is S _____ per Thousand.

The total amount of premium charges is $ _____. (The above must be filled in by the Corporate Surety)

IMPORTANT NOTE

Surety Company executing Bond must be authorized to transact business in the State of New Jersey and rated as "A" or better as determined by A.M. Best Company.

FORM OF PROPOSAL (BID FORM)

PROPOSAL OF _____ hereinafter called "BIDDER," a/an

☐ corporation

☐ partnership (check applicable term)

☐ individual

organized and existing under the laws of the State of _____and doing business

as _____.

Bidder's Address: _____

_____

_____

Bidder's Phone Number: _____

TO: BOARD OF TRUSTEES OF ATLANTIC CAPE COMMUNITY COLLEGE
5100 Black Horse Pike
Mays Landing, New Jersey 08330 (hereinafter called College.")

Members of the Board:

1. The bidder, in compliance with your Legal Notice inviting bids for the Bid of the Wind Safety Training Center located at 1535 Bacharach Blvd Atlantic City, New Jersey for the Atlantic Cape County Community College, having examined the specifications, drawings, Request for Proposal, various forms and related contract documents and the site of the proposed work and being familiar with all the conditions surrounding the proposed contract or the proposed construction, including the availability of materials and labor, hereby proposes to furnish and/or install the equipment, labor, materials and supplies and/or to construct the project in accordance with all the aforesaid documents within the time set forth therein and at the prices stated below. These prices are to cover all expenses incurred in supplying and/or installing the materials and equipment or performing the work required by the Request for Proposal of which this Bid Form is a part.

2. The bidder acknowledges receipt of the following Addenda:

Addendum No._____ Dated: _____

Addendum No._____ Dated: _____

Note: Failure to acknowledge all issued Addenda is a material defect to the bid.

3. The bidder agrees to deliver and/or install the materials and equipment and complete the project as described in the contract documents for the Base Bid Sum (words and numbers) of:

Prime Bidders shall be DPMC Classified for trades C008 (General Construction) or C009 (General Construction/Alterations and Additions). Provide proof of valid DPMC Notice of Classification, Total Amount of Uncompleted Contracts, (Form DBC-701), the Certification of No Material Adverse Change in

Status Affidavit, Proposition of Surety, Consent of Surety and Trade License (when applicable) for the prime bidder and the listed subcontractors at the time of the bid submittal. Provide all subcontractor information per 18A:64A-25.25.

SINGLE OVERALL CONTRACT:

BASE BID _____ **Dollars**

(To Be Written in Full)

($_____**)**

(Figures)

ALLOWANCES (TO BE INCLUDE IN THE BASE BID):

ALLOWANCE No. 1: CONTINGENCY ALLOWANCE

Contractor to include **Fifty Thousand Dollars ($50,000.00)** in its base bid proposal to address unforeseen conditions that may be encountered during the course of the construction. Prior to commencing with any work to be billed against this allowance, the Contractor must submit pricing information for review and consideration and receive written direction to proceed from the Architect. Any excess allowance not used at substantial completion will be deducted from the contract. The Contractor shall submit tickets and receipts to substantiate costs incurred for allowance work. This is to be identified as an Allowance on the successful contractor's schedule of values.

NOTE: If written amount differs from the Numerical Figures, only the Written amount will be accepted as the correct BID. No conditions, limitations or provision may be placed on a bid.

4. The bidder understands that the College reserves the right to reject for any reason any and all bids and to waive any informalities in the bidding.

5. The bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 days after the actual opening of the bids.

6. Within 10 days after receipt of written notice of acceptance of this bid and the award of the contract, the bidder will execute the contract with the College, and will deliver a performance payment bond and insurance certificate required by the RFP.

7. The bidder hereby certifies that all of the figures, computations and additions used in estimating the bid herein have been carefully checked and are accurate in all respects, and no claim shall be made as the basis for withdrawal of this bid after opening on the grounds of mathematical error.

8. The Forms noted below are part of the Bid package and must be properly completed and submitted with Bid Proposal. Failure to provide any items noted below may cause disqualification of Bid Proposal in accordance with the law. Proposals shall be submitted in triplicate on the Form of Proposal furnished by the Architect properly filled out in the manner designated and duly executed, including Affidavits.

Enclose one (1) original and two (2) copies of the Proposal. Proposal Forms shall not be altered or added to in any way.

a. Form of Bid Proposal

b. Certified Check or Form of Bid Bond

c. Surety Disclosure Statement and Certification (Form of Proposition of Surety) and evidence of performance security from the prime bidder all subcontractors to whom the bidder will subcontract the work.

d. Consent of Surety for prime bidder and/or all subcontractors to whom the bidder will subcontract the work at the time of the bid submittal. Note, if the General Contractor's Consent of Surety covers any or all subcontractors, then the Consent of Surety is not required for subcontractors who are covered by the General Contractor's Consent of Surety. General Contractor to provide proof at the time of bid.

e. Subcontractor's Identification Form

f. Prevailing Wage Compliance Declaration

g. Hold Harmless Agreement

h. Site Visit Verification

i. Affidavit of Non-Collusive

j. Stockholder Disclosure Certification

k. No Material Change of Circumstances Affidavit. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

l. Affirmative Action Language: Exhibit B and Affirmative Action Acknowledgment

m. Disclosure of Investment Activities in Iran (Section 004540 Form).

n. Bidder's Certification Regarding Debarment / Disqualification / Suspension

o. Certification of Non-Debarment for Federal Government Contracts

p. Contractor's Equipment Certification

q. Notarized State of New Jersey Form (DBC 701) noting total amount of uncompleted contracts. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal. This form may be obtained from the New Jersey Department of Treasury website under the Division of Property Management and Construction, Division Pages, Forms.

r. Certificate by the Department of Labor indicating compliance with "The Public Works Contractor Registration Act" (P.L. 1999, c.238) for compliance with this Act. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

s. Proof of valid DPMC NOTICE OF CLASSIFICATION, as issued by the State of New Jersey, Department of Treasury, Division of Property Management and Construction (DPMC). Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

t. Contractor or Trade License required under applicable New Jersey Law for any trade or specialty area (applicable to plumbing and electrical trades).

Written Signature: _____

Printed/Typed Signature: _____

Title: _____

Name of Firm: _____

Address: _____

Telephone Number: _____ Fax Number _____

E-Mail Address: _____ Taxpayer Federal ID Number _____

NOTE: DO NOT FAIL TO EXECUTE THIS OATH OR AFFIDAVIT:

AFFIDAVIT

STATE OF _____)

SS:

COUNTY OF _____)

(Name of Bidder or Bidders, or if Bidder is a corporation, name of Officer or Agent making Affidavit.)

being duly sworn, says that the several declarations and matters stated in the annexed estimate are in all respects true.

I hereby certify that I am the _____ of the bidder submitting this proposal and that I am authorized to submit this bid on behalf of the bidder and that the information contained in all bidding documents submitted by the bidder is true and accurate. I further certify that the bidder and all subcontractors listed herein have sufficient means and experience to complete the work in accordance with the project specifications. I am aware that if any of the foregoing statements made by me are willfully false, I am subject to punishment.

Signature of:

_____
(Bidder, if Bidder is an Individual)

_____
(Partner, if Bidder is a Partnership)

_____
(Officer, if Bidder is a Corporation)

Sworn and subscribed before me this

_____ day of _____ 20 ____.

NOTARY PUBLIC _____
(Signature)

_____
(Print Name)

SEAL

Notary Public - State of _____

My Commission Expires _____

SECTION 004363 - HOLD HARMLESS AGREEMENT

It is further agreed that the undersigned hereby agrees to defend, indemnify and hold harmless the Board of Trustees, its officers, employees, volunteers, and agents, from and against all claims, damages, losses and expenses including reasonable attorney's fees in case it shall be necessary to file an action, arising out of performance of the work herein, which is; 1) for personal or bodily injury, illness or death, or for property damage, including loss of se, and; 2) caused in whole or in part by

_____ (Name of contractor)

negligent act or omission or that a subcontractor or that of anyone employed by them or for whose acts contractor or subcontractor may be liable. This indemnification and agreement shall apply in all instances whether the Board of Trustees, its officers, employees, volunteers and / or agents, is/are made a party to the action or claim or is subsequently made a party to the action by third-party-inpleading or is made a part to a collateral action arising, in the whole or in part, from any of the issues emanating from the original cause of action or claim.

Full Name of Contractor:_____

Business Address:_____

_____

Zip Code: _____

Telephone Number: _____

Project Description: _____

_____

Authorized Person Printed Name: _____

Authorized Person Signature: _____

Witness Printed Name: _____

Witness Signature: _____

INFORMATION FOR BIDDERS

A. GENERAL TERMS

1. All papers bound or attached to these bid documents are a necessary part hereof. All bids are submitted subject to the requirements and conditions in the bidding documents.
2. Proposals for the Contracts as listed in the Public Notice as hereinafter described will be received for the performance of the Project. The bids shall cover all cost of any nature, incident to and growing out of the Work. In explanation but no in limitation thereof, these costs shall include the cost of all work, labor, materials, equipment, transportation and cost of all else necessary to perform and complete the Project in the manner and within the time required, all incidental expenses in connection therewith, all costs on account of loss by damage or destruction of the Project to the extent that the cost of such loss is not recovered from insurance carried by the Owner and the Contractor, and any additional expenses for unforeseen difficulties encountered, for settlement of damages and for replacement of defective work and materials.
3. Examination of Documents. Plans, specifications, and other bidding documents may be examined during normal business hours (8:00 AM to 5:00 PM) at the architect's office at the address specified in the Public Notice.
4. Authority of Atlantic Cape Community College. On all questions concerning the interpretation of specifications; the acceptability of quality of materials or items furnished and work performed; the execution of the work; and the determination of payment due or to become due, the decision of the Atlantic Cape Community College Board of Trustees shall be final and binding.
5. Submission of Bids. Bidders are to seal their bids in an envelope. The outside of this envelope must display the title of the bid and the name and address of the bidder. No bids will be received after the date and time specified herein unless the contract is re-advertised for bids. Bidders are responsible for ensuring that their bids arrive at the Purchasing Office before the opening date and time. Bids delivered in person or by express service should be delivered directly to the Purchasing Office at the Atlantic Cape Community College, 5100 Black Horse Pike, Mays Landing, New Jersey 08330. Bids sent via regular mail should be sent to Purchasing Office at the Atlantic Cape Community College, 5100 Black Horse Pike, Mays Landing, New Jersey 08330, Building J, Room 230. Bids mailed to the Post Office box must be received one day prior to bid receipt date to insure timely receipt at the Bid Opening location. Neither the Atlantic Cape Community College, nor the Architect will assume any responsibility for Bids mailed or misdirected in delivery.
6. Modifications of Bids. Any bidder may modify a bid at any time prior to the scheduled closing time for the receipt of bids. The modification must bear an original signature of the bidder. It must be in a sealed envelope; the outside of this envelope must display the title of the bid, the name and address of the bidder, and the word "MODIFICATION."
7. Withdrawal of Bids. Any bid may be withdrawn prior to the scheduled time for opening bids or the authorized postponement thereof. No bidder may withdraw a bid within 60 days after the actual date on which it is opened.
8. Qualifications of Bidder. The College may make such investigation as it deems necessary to determine the ability of the bidder to perform the terms of the contract, and the bidder shall furnish the College all the information for this purpose which the College may request. The College reserves the right to reject any bid if its investigation of the bidder reveals that, in the opinion of the College, the bidder is not properly qualified to carry out the obligations of the contract and complete it as outlined herein.

9. Bidding Contractors must be pre-qualified as either "C008 General Construction" or "C009 General Construction / Alterations and Additions". Each bid must be accompanied by an affidavit so certifying.

10. Subcontracts. Each bidder is hereby advised that any person, firm or other party to whom it is proposed to award a sub-contract under the bidder's contract must be acceptable to the College. Evidence of sub-contractor performance security must be submitted with the bid. Subcontractor's performance security can be provided by the Contractor or Subcontractor. All other certifications required of the bidder must also be obtained from any sub-contractor and furnished to the College prior to commencement of work. If Contractor intends and is licensed to also executing plumbing and gas fitting work; heating and ventilating systems and equipment; electrical work; structural steel and ornamental iron work, as applicable to project's scope of work, this must be noted on subcontractor identification form (004336).

11. Under the County College Contracts Law, N.J.S.A. 18A:64A-25.25, all bids submitted shall set forth the name or names of, and evidence of performance security from, all subcontractors to whom the bidder will subcontract the work for general construction, plumbing and gas fitting work, heating and ventilating systems and equipment, or electrical work, or structural steel and ornamental iron work.

12. Interpretations, Clarifications and Addenda. Should any bidder find what appears to be an ambiguity, discrepancy or omission in any of the documents, the bidder shall at once notify the College which will determine whether written interpretations should be sent to all bidders. Every request for interpretation shall be addressed in writing to the College and, to be given consideration, must be received at least nine business days prior to the date fixed for the opening of bids. All such interpretations and supplemental instructions will be issued in the form of written clarifications or addenda which will become part of the contract; and all such interpretations and supplemental instructions will be mailed to all prospective bidders at their respective addresses furnished for such purposes not later than seven business days prior to the date fixed for the opening of bids. The failure of any bidder to receive any such addendum or interpretation shall not relieve any such bidder from any obligation under this bid as submitted. No oral interpretations will be made to any Bidder as to the meaning of the drawings and specifications.

    Addenda shall take precedence over the original drawings and specifications insofar as the definition, interpretation and intent of the Work are concerned. With the list of addenda, the order of precedence will be in ascending order of addenda numbering.

13. In the event of inclement weather, the College maintains the right to reschedule the bid opening.

14. New Equipment. All equipment, supplies and materials for which bids are requested shall be new, unless otherwise specified.

15. Obligation of Bidders. All bidders will be presumed to be familiar with the plans and specifications, notice to bidders, and all documents included in the bid documents including all addenda; and to have inspected the site. In addition, all bidders must inform themselves fully of the conditions relating to performance of the contract, any construction involved and the employment of any labor thereon. Failure to do any of the foregoing will not relieve any bidder of any obligation with respect to the bid as submitted and/or contract.

16. Waiver of Informalities/Rejection of Bids. The College may consider informal any bid not prepared and submitted in accordance with the bid documents and may waive any informalities; or it may for any reason reject any and all bids.

B. APPLICABLE LAWS AND REGULATIONS

1. Bidders on service contracts, or on equipment which require installation by the contractor, are advised that the provisions of P.L. 1963, c. 150 (New Jersey Prevailing Wage Act) will apply to and be part of the contract. For job categories not covered under prevailing wage rates, bidders are required to pay to workers at least the legally established minimum wage at all times during the contract period.

2. Bidders are required to comply with the affirmative action requirements of P.L. 1975, c. 127 {NJAC 17:27}. For construction contracts, the successful vendor must submit State of New Jersey Form AA-201 (Initial Manning Report) and subsequent ongoing Manning Reports.

3. All equipment supplied to Atlantic Cape Community College and all installation work performed at Atlantic Cape Community College must comply with PEOSHA regulations and meet PEOSHA standards.

4. The successful bidder is required to keep informed of and to comply with all authorities having jurisdiction over the subject matter of the contract. The Owner shall be responsible for reimbursing the Contractor for all permits, governmental fees and licenses necessary for the lawful execution and completion of the work required by the contract. The Contractor will obtain construction permits from the Township of Hamilton, Atlantic County. The College is an exempt organization and no fee will be required for construction permits. The successful bidder is required to assist the Owner in obtaining permits.

5. Construction Contracts: Each bidder shall be pre-qualified in accordance with the standards of the New Jersey Department of the Treasury, Department of Building and Construction (N.J.A.C. 17:19-2.1 et. seq.), and shall submit with the bid a copy of the current Notice of Classification and Total Amount of Uncompleted Contracts.

6. State of New Jersey – Laws of 1977 Chapter 33: Conflict of Interest: No corporation or partnership shall be awarded any contract or shall any agreement be entered into for the performance of any work or the furnishing of any materials or supplies, the cost of which is to be paid with or out of any public funds, by the State, or any county, municipality or school district, or any subsidiary or agency of the State, or of any county, municipality or school district, or by any authority, board, or commission which exercises governmental functions, unless prior to the receipt of the bid or accompanying the bid of said corporation or said partnership, there is submitted a statement setting forth the names and address of all stockholders in the corporation or partnership who own 10% or more of its stock, or any class or of all individual partners in the partnership who own a 10% or greater interest therein, as the case may be. If one or more such stockholder or partner is itself a corporation or partnership, the stockholders holding 10% or more of that corporation's stock, or the individual partners owning 10% or greater interest in that partnership, as the case may be, shall also be listed. The disclosure shall be continued until names and addresses of every non-corporate stockholder and individual partner exceeding the 10% ownership criteria established in this act has been listed.

7. Americans with Disabilities Act (A.D.A.) Equal Opportunity for Individuals with Disability: The Contractor and the County College do hereby agree that the provisions of Title II of the Americans With Disabilities Act of 1990 (the "ACT") (42 U.S.C. S12101 et seq.) which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant thereunto, are made a part of this contract. In providing any aid, benefit, or service on behalf of the County College pursuant to this contract, the Contractor agrees that the performance shall be in strict compliance with the Act.

8. Construction Contracts: Required Contractor Registration for Public Works Projects: "The Public Works Contractor Registration Act" (P.L. 1999, c.238), effective April 11, 2000, requires that all contractors and subcontractors must be registered with the New Jersey Department of Labor in order to bid on or engage in any contract for public work. Bidders must include evidence of registration, i.e. certificate from the Department of Labor indicating compliance, or copy of application for registration.

9. The College requires that the contractor demonstrate a safety and health program/plan referencing first aid, fire protection, housekeeping, illumination, sanitation, personal protective equipment, medical, exits and emergency action plans. This document will be site specific for inspection and training and will serve to communicate these work practices to all project contractors.

10. Business Registration Certificate, P.L. 2009, c.315: Effective September 1, 2004, N.J.S.A. 52:32-44 requires mandatory "Business Registration" for any vendor doing business in the State of New Jersey. A copy of the Business Registration Certificate issued by the New Jersey Department of Treasury / Division of Revenue shall be provided no less than 10 (ten) business days prior to Board Approval. Please contact New Jersey Department of Treasury / Division of Revenue with any questions or concerns at (609) 292-1730.

    Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration, or that provides false business registration information, shall be liable for a penalty of $25 for each day of violation, not to exceed $50,000 for each business registration copy not properly provided under a contract with a contracting agency.

11. Record Retention: N.J.A.C. 17:44-2.2 requires that the selected vendor shall maintain all documentation for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

12. Political Contributions: Any business entity making a contribution of money or any other thing of value, including an in-kind contribution, or pledge to make a contribution of any kind to a candidate for or the holder of any public office having ultimate responsibility for the awarding of public contracts, or to a political party committee, which has received in any calendar year $50,000 or more in the aggregate through agreements or contracts with a public entity, shall file an annual disclosure statement with the New Jersey Election Law Enforcement Commission, established pursuant to section 5 of P.L 1973, c83 (C. 19:44A-5), setting forth all such contributions made by the business entity during the 12 months prior to the reporting deadline.

C. PREPARATION OF BIDS

1. All bids shall be made on the Bid Form which is included in the bid documents. All blanks on the Bid Form must be appropriately filled in with cost amounts. Any alterations or erasures must be initialed by the bidder. Bid prices must be in ink or typewritten, in both words and figures. No conditions, limitations or provision may be placed on a bid.

2. Each bid must give the full business address of the bidder and be signed by the bidder with his/her usual signature. Bids (including all required supporting documents) by partnerships must be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and title of the person signing. Bids, including all required supporting documents, by corporation must be signed with the legal name of the corporation, followed by the name of the state of incorporation and by the signature and title of the president, secretary, or other person authorized to bind it in the matter. The name of each person signing shall also be typed or printed below the signature. A bid by a person who affixes to his/her signature the word "president," "secretary," "agent," or other title without disclosing his/her principal, may be held to be the bid of the individual signing. When requested by the College, satisfactory evidence of the authority of the officer signing in behalf of a corporation shall be furnished.

3. Prices should include a sufficient amount to cover the cost of any and all work or material called for in addenda to the specifications or other instructions issued during the bidding period. Such additions shall automatically become a part of the contract.

4. Prices quoted shall include freight or other charges incidental to the delivery of the item bid upon.

5. Alternate Bids and Unit Prices for the various portions of the Work or Contracts shall be as stated in other Sections of the Specifications.

6. Attention is called particularly to the requirements for filling in all Alternate Bids called for on the Proposal Form, as the Owner reserves the right to award a Contract based upon the possible inclusion of one or more such Alternate Bids. The amounts of the Alternate Bids shall include any and all modifications to related, adjacent or surrounding work made necessary by use of such Alternate Bids. The Alternate Bids must be stated as additions to or deductions from the Base Bid, unless otherwise noted.

7. The term "No Bid" shall not be used with respect to Alternate Bids requested on the Proposal Form. The Bidder who does not desire to make a change from the Base Bid under a particular Alternate Bid shall so indicate by using the words "No Change". Failure to bid or use of the term "No Bid" on any Alternate may cause rejection of an entire bid.

8. Conditions, limitations or provisos attached by the Bidder to the Proposal may cause its rejection.

9. The College is established under the authority of the State of New Jersey and is entitled to exemption from Federal, State and local taxes, including the New Jersey Sales Tax. No amount attributable to taxes should be included in bid prices.

10. When a catalog reference follows the description of any item in the specifications, it is intended as a means of more fully describing the item in the shortest possible space and is to be regarded as part of the description of the item. Catalog numbers have been adopted from their respective sources for purposes of identification and to establish minimum requirements for quality and design. The College will consider products of manufacturers which are equal in quality and design to the items specified if such products in all ways meet the specifications. The decision of the College as to whether an alternate or substitute is in fact equal shall be final.

    After Award of Contract, any time and materials expended by the Architect and his engineers for the review of any substitutions will be charged back to Contractor in the form of Change Order.

11. Proposals shall be submitted in triplicate on the Form of Proposal furnished by the Architect properly filled out in the manner designated and duly executed, including Affidavits. Enclose one (1) original (Marked as "ORIGINAL" on the cover) and two (2) copies (Marked as "COPY" on the cover) of the Proposal. Proposal Forms shall not be altered or added to in any way. Lump

sum bid or base bid prices shall be filled in, in ink or typewritten, in both words and figures. In case of discrepancy, the amount described in words shall govern.

a. Form of Bid Proposal

b. Certified Check or Form of Bid Bond

c. Surety Disclosure Statement and Certification (Form of Proposition of Surety) (Section 004316 Form) and evidence of performance security from the prime bidder all subcontractors to whom the bidder will subcontract the work.

d. Consent of Surety for prime bidder and/or all subcontractors to whom the bidder will subcontract the work at the time of the bid submittal (Section 004319). Note, if the General Contractor's Consent of Surety covers any or all subcontractors, then the Consent of Surety is not required for subcontractors who are covered by the General Contractor's Consent of Surety. General Contractor to provide proof at the time of bid.

e. Subcontractor's Identification Form

f. Prevailing Wage Compliance Declaration

g. Hold Harmless Agreement

h. Site Visit Verification

i. Affidavit of Non-Collusive, pursuant to N.J.S.A. 52:34-15.

j. Stockholder Disclosure Certification

k. No Material Change of Circumstances Affidavit. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

l. Affirmative Action Language: Exhibit B and Affirmative Action Acknowledgment

m. Disclosure of Investment Activities in Iran

n. Bidder's Certification Regarding Debarment / Disqualification / Suspension

o. Certification of Non-Debarment for Federal Government Contracts

p. Contractor's Equipment Certification

q. Notarized State of New Jersey Form (DBC 701) noting total amount of uncompleted contracts. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal. This form may be obtained from the New Jersey Department of Treasury website under the Division of Property Management and Construction, Division Pages, Forms.

r. Certificate by the Department of Labor indicating compliance with "The Public Works Contractor Registration Act" (P.L. 1999, c.238) for compliance with this Act. Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

s. Proof of valid DPMC NOTICE OF CLASSIFICATION, as issued by the State of New Jersey, Department of Treasury, Division of Property Management and Construction (DPMC). Required for Bidder and all specialty trade sub-contractors named on the Form of Bid Proposal.

t. Contractor or Trade License required under applicable New Jersey Law for any trade or specialty area (applicable to plumbing, mechanical and electrical trades).

D. METHOD OF AWARD

1. Notification of the acceptance of the bid and award of the contract will be made as soon as practical after the opening of the bids. Contract will be awarded after due consideration of all factors relevant to the bidder's responsibility as well as the price, so that the College, consistent with law, will gain the advantage of a contract which in its judgment will best serve the interests of the College and the public.
2. Award made to a Bidder not a resident of the State of New Jersey is conditioned upon Bidder designating a proper agent in the State of New Jersey on whom service can be made in the event of litigation.
3. If the successful Bidder is a corporation not organized under the laws of New Jersey, the award of contract and payment of consideration there under shall be conditioned upon Corporation promptly filing a certificate of doing business in the State of New Jersey pursuant to N.J.S.A. 14A:13-2 and complying with provisions of N.J.S.A. 14A:13-4.
4. In accordance with N.J.S.A. 40A:11-1, when alternates bids are requested by the contracting unit and included as part of the contract bid package, the College intends to award the alternates bids in the order of ranking indicated, starting with alternate Bid AB-1.
5. The determination of responsive, lowest bidder shall be made by the College based upon the verification that a submitted bid package is complete, the price of the base bid, along with the price indicated for the alternate bids that are accepted by the College.
6. In accordance with N.J.S.A. 18A:64A-25.20, whenever two or more bids of equal amounts are the lowest bids submitted by responsible bidders, the Owner may award the Contract to any one of such bidders as in its discretion it may determine.
7. Within 10 days after the giving of the Notice of Award, the successful Bidder shall be required to execute the Contract with the College. The form of agreement shall be the AIA A101-2017 edition, Standard Form of Agreement between Owner and Contractor, used with the A201-2017 edition, General Conditions of the Contract for Construction.
8. Bidder acknowledges that this bid and the award of a contract are governed by the County College Contracts Law N.J.S.A. 18A:65A-25.1 et. seq. and that any legal challenges to the bidding process, the award or non-award of a contract, or the rejection of any bids, must be pursued before the Board of Trustees in accordance with P.L. 1994 Ch.48, Sec.6(f). The challenge or objection must be presented by filing a petition with the secretary of the Board of Trustees within ten (10) calendar days of the decision to award or not award a contract. Proceedings on the petition shall be governed by the Rules Governing Hearings before the Board of Trustees of Atlantic Cape Community College, which rules may be obtained at the office of the Dean of Administration and Business Services.

E. BID SECURITY

1. Each bid must be accompanied by:
   a. a certified check, or a cashier's check of the bidder in the amount of 10% of the base bid amount made out to "Atlantic Cape Community College," or
   b. a bid bond made payable to the College prepared and duly executed by the bidder as principal, having as a surety thereon a surety company approved by the College in the amount of 10% of the total amount of the bid.
2. The surety company on a bid bond must be acceptable to the College, authorized to transact business in New Jersey, and must be named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies"

as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. Where an attorney-in-fact has signed the bid bond, a certified and effectively dated copy of the power of attorney must be presented with the bond.

3. Pursuant to N.J.S.A. 18A:64A-25:18, the checks or bid bonds of all except the three lowest bidders will be returned, if requested, after ten days from opening of bids, Sundays and holidays excepted. Within three days after the award of contract and the approval of the Contractor's performance payment bond, the bid security of the remaining unsuccessful bidders will be returned, if requested, Sundays and holidays excepted.

4. The bid security of the successful bidder shall be forfeited and retained as liquidated damages if he/she neglects or refuses to execute the contract and, where applicable, furnish a performance/payment bond within ten (10) days after notice of the award of the contract. Acceptance of forfeiture by the College shall not limit the remedies available to the College upon default, and it may recover full damages including Alternate Bids, which the Owner wishes to accept and that amount for which the Owner is obligated on award to another Bidder, in addition thereto in accordance with law.

5. The proposal guarantee shall similarly be forfeited as liquidated damages if the qualification Questionnaire or Bid Affidavit required to be submitted contains a false, deceptive or fraudulent statement.

F. PERFORMANCE/PAYMENT BOND

1. Pursuant to N.J.S.A. 18A:64A-25.17, Proposals shall be accompanied by a Performance Security in form as bound in these documents, assuring that satisfactory arrangements have been made between the surety and the Bidder by which surety agrees to furnish the Bidder with a Performance Bond and Maintenance Bond to include Surety Disclosure Statement and Certification in form as bound herein. The Performance Security shall be executed by an approved surety company authorized to do business in the State of New Jersey or by the individual if an individual surety is offered by the bidder.

2. Pursuant to N.J.S.A. 18A:64A-25.25, Bidders submitting proposals for this Contract shall include Performance Security in form as bound in these documents, as hereinbefore specified.

3. The Bidder to whom the Contract has been awarded shall, within ten (10) days after notification of award of contract, furnish and deliver a Performance and Payment Bond, equal to one hundred percent (100%) of the Contract Amount. If, at any time after execution and approval of a Contract and Performance-Payment Bond required by the Contract, such Bond shall cease to be adequate security for the Owner, the Contractor shall, within five (5) days after such notice to do so, furnish a new or additional Bond, inform sum and signed by such sureties as shall be satisfactory to the Owner. No further payment shall be deemed due nor shall any further payment be made to the Contractor unless and until such new or additional Bond be furnished and approved. Surety must be authorized to do business in the State of New Jersey.

4. Each bidder must submit with his bid a certificate from a surety company that it will provide the bidder with the bond described in paragraph F.3.

5. The surety company on a performance/payment bond must be acceptable to the College, must be authorized to transact business in New Jersey, and must be named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. The surety shall comply with all provisions of N.J.S.A. 18A:64A-25.17(c) et. seq. Evidence of compliance must be submitted in the form of the "Surety Disclosure Statement and Certification" which must be included with the bid. Failure to submit this statement will result in rejection of the bid.
6. Where an attorney-in-fact has signed the performance/payment bond, a certified and effectively dated copy of the power of attorney must be presented with the bond.
7. Prior to the start of the guarantee period and before the final payment is made, the Contractor shall provide the Owner with a Maintenance Bond in the amount stipulated in Section 006119, to insure the replacement or repair of defective materials or workmanship during the one-year guarantee period.
8. The cost of all Bonds shall be paid for by the Contractor.
9. Attorneys-in-fact who sign Bid Bonds, Performance-Payment Bonds, Maintenance Bonds and Performance Security forms must accompany each bond or proposition with a certified and effectively dated copy of their power-of-attorney.

G. IRREVOCABLE LETTER OF CREDIT

1. At the time set for signing the contract, the successful bidder may deliver an Irrevocable Letter of Credit (in lieu of the Performance/Payment Bond) in the amount of 100% of the accepted bid on the forms included in the RFP. The premium for such letter shall be paid by the bidder and will be part of the price quoted in the bid.

H. PERFORMANCE OF CONTRACT

1. Failure of a bidder to execute a contract awarded to him/her, or to comply with any or all of the terms and conditions thereof, may disqualify him/her from receiving future contracts. Such disqualification or the failure to disqualify shall not limit the remedies available to the College upon default and it may recover full damages in addition thereto in accordance with law.
2. Insofar as possible and if applicable, the successful bidder in carrying out the contract must employ such methods or means as will not cause any interruption of, or interference with, the work of any other contractor or any of the customary operations of the College.
3. Bidders shall acquaint themselves with the conditions to be found at the College and shall assume all responsibility for the performance of the contract. The College will not accept deliveries for contractors.
4. Successful bidders will guarantee:
    a. to furnish adequate protection for all work and to repair damage of any kind for which they or their agents or employees are responsible;
    b. to carry adequate insurance, as required by General and Supplementary Conditions, to protect the College from any and all claims on behalf of any person, firm or corporation arising out of any action or work performed by the successful bidders or their agents, or employees relating to the performance of the contract.
5. Indemnification.

a. The successful bidder shall indemnify and hold harmless the College and its agents and employees from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from the performance of the contract, provided that any such claim, damage, loss or expense

1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom, and

2) is caused in whole or in part by any negligent act or omission of the successful bidder, any subcontractor of the successful bidder, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

b. With respect to claims against the College by an employee of the successful bidder, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the successful bidder or any subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

c. The College may deduct amounts due to it under paragraph H.6 of this document from any sum or sums which may be due to the successful bidder under the contract.

6. The College agrees to make payment for the performance of the contract, subject to additions and deductions, within 60 days after performance has occurred and been found in compliance with the contract. Title to all supplies, materials and equipment shall pass to the College at the time of said payment.

7. Neither the final certificate of payment nor any provision in the bid documents or contract nor partial or entire use of the equipment, supplies or services by the College shall constitute an acceptance thereof if not in accordance with the specifications and other documents included in the RFP, nor relieve the successful bidder of liability in respect to any express warranties or for faulty materials or workmanship. The successful bidder will agree to promptly remedy, without cost to the College, any defect which shall appear within a period of one year from the date of final acceptance if a standard manufacturer's warranty does not apply, unless a longer period is specified or allowed by the manufacturer. The College will give notice of observed defects with reasonable promptness.

8. The work is to be completed as per the schedule indicated in Specification Section 011000 Summary.

I. INSURANCE

1. Before commencing the work, each Contractor shall procure and maintain until completion and final acceptance of the work and shall cause each subcontractor to so procure and maintain, at least the following insurance:

a. Worker's Compensation and Employer's Liability. Worker's Compensation (statutory limits) and Employer's Liability Insurance with a limit of $500,000.00 covering each and every worker employed in connection with the work under contract, as provided for in each and every State and Federal statute applicable to Worker's Compensation.

b. Comprehensive General Liability. Comprehensive General Liability Insurance covering work under the contract (including premises/operations, products/completed operations, independent contractors, personal injury, broad form property damage and contractual liability coverage) with at least the following limits:

1) Bodily Injury and Personal Injury: $1,000,000.00 per occurrence.

2) Property Damage: $1,000,000.00 per occurrence.

c. Comprehensive Auto Liability. Comprehensive Auto Liability insurance covering all owned, hired and non-owned vehicles with at least the following limits of liability:

1) Bodily Injury: $1,000,000.00 per occurrence.

2) Liability: $1,000,000.00 per occurrence.

3) Property Damage Liability: $1,000,000.00 per occurrence.

2. Excess Liability Limits. Excess Liability coverage for personal injury and property damage shall be provided by the Contractor with a minimum limit of liability of $5,000,000.00.

3. Contractors may carry whatever additional insurance deemed necessary to protect themselves against hazards not covered by the Owner's Property Insurance, including coverage for theft, collapse, water damage, materials and equipment stored on site, and for materials and equipment stored off site, and against loss of owned or rented equipment and tools owned by mechanics or any tools, equipment, scaffolding, staging, towers and forms owned or rented by the Contractor, the value of which is not included in the cost of the work. Owner's "All Risk" Insurance does not cover theft of material unless installed and made an integral part of the building.

4. Subcontractors: Contractors shall require all their subcontractors to provide the aforementioned coverage as well as any other coverage that the Contractors may consider necessary and any deficiencies in their coverage and policy limits will be the sole responsibility of the contractors.

5. Certificates of Insurance. Before commencing operations, Contractor shall furnish to Owner a Certificate of Insurance evidencing:

a. The required coverage and limits written through an insurance company or companies acceptable to the Owner.

b. The effective and expiration dates of the policies.

c. Thirty (30) days written notice of cancellation or material change in any policies.

d. That a Waiver of Subjugation endorsement has been attached to all policies.

e. The fact that the Contractor's policies are primary insurance.

f. The contract number.

g. That Atlantic Cape Community College and their agents, and the Architect and their agents, are listed as additional insured.

6. Waiver of Subjugation: All insurance policies of the Contractor will be endorsed to waive all right of subjugation against the Owner.

7. The Owner as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within five (5) days after the occurrence of the loss to the Owner's exercise of this power. The Owner as trustee shall, in that case, make settlement with the insurer.

8. Cancellation, Reduction, or Non-Renewal: If the insurance policies required herein are cancelled, or the coverage is reduced below the minimum specified, or expiration without renewal occurs before completion of the work, the Owner, at this option, may obtain the said certificates or policies, and charge the cost against money due the Contractor pursuant to the terms of this contract.

9. Builder's Risk Insurance: The Contractor shall be required to secure and maintain Builder's Risk Insurance for the project. Refer to Specification Section / Supplementary Conditions for additional information.

J. UNION LABOR

1. Atlantic Cape Community College encourages Union Labor participation on all construction projects, and encourages bidders to contact the local labor union representatives to discuss the potential for the inclusion of union labor on projects. This project will include a Project Labor Agreement to be executed by the General Contractor.

END OF SECTION 002113

DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

_____
Company Name

Pursuant to Public Law 2012, c. 25, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that the person or entity, or one of the person or entity's parents, subsidiaries, or affiliates, is not identified on a list created and maintained by the Department of the Treasury as a person or entity engaging in investment activities in Iran. If the Department of Treasury finds a person or entity to be in violation of the principles which are the subject of this law, the Department of Treasury shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the person or entity.

I certify, pursuant to Public Law 2012, c. 25, that the person or entity listed below for which I am authorized to bid:

☐ is not providing goods or services of $20,000,000 or more in the energy sector of Iran, including a person or entity that provides oil or liquefied natural gas tankers, or products used to construct or maintain pipelines used to transport oil or liquefied natural gas, for the energy sector of Iran, AND

☐ is not a financial institution that extends $20,000,000 or more in credit to another person or entity, for 45 days or more, if that person or entity will use the credit to provide goods or services in the energy sector in Iran.

In the event that a person or entity is unable to make the above certification because it or one of its parents, subsidiaries, or affiliates has engaged in the above-referenced activities, a detailed, accurate and precise description of the activities must be provided below to Atlantic Cape Community College under penalty of perjury.

PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT ACTIVITIES IN IRAN

You must provide a detailed, accurate and precise description of the activities of the bidding person/entity, or one of its parents, subsidiaries or affiliates, engaging in the investment activities in Iran outlined above by completing the boxes below.

PROVIDE INFORMATION RELATIVE TO THE ABOVE QUESTIONS. PLEASE PROVIDE THOROUGH ANSWERS TO EACH QUESTION. IF YOU NEED TO MAKE ADDITIONAL ENTRIES, USE ADDITIONAL PAGES

Name:

Relationship to Bidder/Vendor:

DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

Description of Activities:

Duration of Engagement:

Bidder/Vendor
Contact Name: Contact Phone Number:

Certification: I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I attest that I am authorized to execute this certification on behalf of the below-referenced person or entity. I acknowledge that Atlantic Cape Community College is relying on the information contained herein and thereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of contracts with the College to notify the College in writing of any changes to the answers of information contained herein. I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreements(s) with Atlantic Cape Community College and that the College at its option may declare contract(s) resulting from this certification void and unenforceable.

Full Name (Print): Signature:

Title: Date:

Bidder/Vendor:

DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

SECTION 004535 - NO MATERIAL CHANGE OF CIRCUMSTANCES AFFIDAVIT

I, _____ being of full age under oath depose and say:

1. I am a(n) owner, partner, shareholder or officer of the company set forth below and am duly authorized to execute this affidavit on its behalf.

2. A statement as to the financial ability, adequacy of plant and equipment, organization and prior experience of [Bidder], has been submitted to the Department of Treasury within one (1) year preceding the date of opening of bids for this contract.

3. I certify, that there has been no material adverse change in the qualification information of [Bidder] since such statement was submitted to the Department of Treasury except:

_____

_____.

SEAL

_____
TITLE

_____
COMPANY

Sworn to and subscribed
before me on this day
of , 20___.

_____
Notary Public

DOCUMENT– PROJECT LABOR AGREEMENT

1.1 GENERAL INFORMATION

A. A Project Labor Agreement herein referred to as PLA will be required for this project. The Atlantic Cape Community College has a compelling interest in carrying out the project at the lowest cost and with the highest degree of quality; therefore the awarded contractor will negotiate a Project Labor Agreement, a form of pre-hire collective bargaining agreement covering the terms and conditions of the project.

B. Atlantic Cape Community College conditions the award with the negotiation of, in good faith, a Project Labor Agreement, with one or more labor organizations.

C. Any bidder refusing to agree to abide by the conditions of the Project labor Agreement or the requirement to negotiate a Project Labor Agreement shall not be regarded as a responsible bidder.

D. Related Documents:

1. Project Labor Agreement (34 pages)

END OF DOCUMENT

Atlantic Cape Community College

PROJECT LABOR AGREEMENT

ARTICLE 1 – PREAMBLE

WHEREAS, ATLANTIC CAPE COMMUNITY COLLEGE, with its office at 5100 Black Horse Pike, Mays Landing, New Jersey ("ACCC" or "Owner") on behalf of itself, and Project Management Firms acting as Construction Managers, and reflecting the objectives of ACCC, as Owner, desires to provide for the efficient, safe, quality, and timely completion of a certain construction project for the **ACCC at 1535 Bacharach Blvd Atlantic City, New Jersey 08401** (the "Project") in a manner designed to afford lower reasonable costs to ACCC the Owner, and the Public it represents, and the advancement of public policy objectives; and

WHEREAS, this Project Labor Agreement will foster the achievement of these goals, inter alia by:

- Ensuring a reliable source of skilled and experienced labor;
- Standardizing the terms and conditions governing the employment of labor on the Project;
- Permitting wide flexibility in work scheduling and shift hours and times, from those which otherwise might obtain;
- Receiving negotiated adjustments as to work rules and staffing requirements from those which otherwise might obtain;
- Providing comprehensive and standardized mechanisms for the settlement of work disputes, including those relating to jurisdiction, without delay or disruption to the project;
- Avoiding the costly delays of potential strikes, slowdowns, walkouts, picketing and other disruptions arising from work disputes, and promote labor harmony and peace for the duration of the project;
- Furthering public policy objectives as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry;
- Expediting the construction process;
- Stabilizing wages, hours and working conditions for the craft workers on the project; and
- Ensuring a satisfactory, continuous and harmonious relationship between the parties hereto.

WHEREAS, the signatory Unions desire the stability, security and work opportunities afforded by a Project Labor Agreement; and

WHEREAS, the Parties desire to maximize Project safety conditions for both workers and the public.

NOW, THEREFORE, the Parties enter into this Project Labor Agreement pursuant to N.J.S.A. 52:38-1 et seq.

SECTION 1. PARTIES TO THE AGREEMENT

This is a Project Labor Agreement ("Agreement") for the certain construction project of the Construction of the Wind Safety Training Center at 1535 Bacharach Blvd Atlantic City, New Jersey 08401. This Agreement is entered into by and between the ACCC and its successors and assigns, and the Contractor(s) to be named (such Contractors joining by Letters of Assent in the form of Schedule B attached), and by the South Jersey Building and Construction Trades Council, ("BTC") on behalf of itself and its affiliated local union members, (each a "local Union", and collectively "Member Unions") and sometimes referred to herein where the context requires as a "Local Union", and together with the Member Unions, the "Unions") for certain construction work to be performed as outlined under Article 3.

ARTICLE 2 – GENERAL CONDITIONS

SECTION 1. DEFINITIONS

Throughout this Agreement, the South Jersey Building and Construction Trades Council shall be referred to as "BTC", the BTC's Members Unions is referred to singularly and collectively as "the Union(s)," and where specific reference is made to "Local Unions" that phrase is sometimes used; the term "Contractor(s)" shall include all signatory Contractors, and their subcontractors of whatever tier, engaged in on-site Project construction work within the scope of this Agreement as defined in Article 3; the Atlantic Cape Community College is referenced as the "ACCC" or "Owner"; the South Jersey Building and Construction Trades Council is referenced as the ("BTC"), the Project Manager or Owner's Representative, is referenced as "PM", and the work covered by this Agreement (as defined in Article 3) is referred to as the "Project".

SECTION 2. CONDITIONS FOR AGREEMENT TO BECOME EFFECTIVE

The Agreement shall not become effective unless executed by all parties designated in Article 1, Section 1 above, and will remain in effect until the completion of the Project. In the event that the ACCC opts not to use a Project Manager, in the ACCC's sole discretion, then the ACCC shall designate an Owner's representative who shall act, under the terms of this Agreement, as a Project Manager.

SECTION 3. ENTITIES BOUND & ADMINISTRATION OF AGREEMENT

This Agreement shall be binding on the BTC, all signatory Unions and the ACCC and all signatory Contractors performing on-site Project work, including site preparation and staging areas, as defined in Article 3. The Contractors shall include in any subcontract that they let, for performance during the term of this Agreement, a requirement that their subcontractors, of whatever tier, become signatories and bound by this Agreement with respect to subcontracted work performed within the scope of Article 3, and as per Schedule A "Local Collective Bargaining Agreements" and per Schedule B "Contractors Letters of Assent".

SECTION 4. SUPREMACY CLAUSE

This Agreement, together with the local Collective Bargaining Agreements appended hereto as Schedule A and Contractor(s) Letters of Assent appended hereto as Schedule B, represents the complete understanding of all signatories and supersedes any national agreement, local agreement or other collective bargaining agreement of any type which would otherwise apply to this Project, in whole or in part, except for all work performed under the National Agreement of the International Union of Elevator Constructors, with the exception of Article VII, IX and X of this Agreement. Where a subject covered by the provisions, explicit or implicit, of this Agreement is also covered by a Schedule A, the provisions of this Agreement shall prevail except for all work performed under the NTD Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Article 7, 9 and 10 of this Agreement, all such work will be governed by the National Agreement. No practice, understanding or agreement between a Contractor and Local Union, which is not explicitly set forth in this Agreement, shall be binding on this Project. It is further understood that no contractor shall be required to sign any other agreement as a condition of performing work on this project. No practice, understanding or agreement between a Contractor and Local Union, which is not explicitly set forth in this Agreement shall apply on this Project.

SECTION 5. LIABILITY

The liability of any Contractor and the liability of any Union under this Agreement shall be several and not joint. The ACCC, PM and any Contractor shall not be liable for any violations of this Agreement by any other Contractor, and the BTC and Local Unions shall not be liable for any violations of this Agreement by any other Union.

SECTION 6. AWARD OF CONTRACTS AND SUSPENSION OF WORK

The ACCC shall require in its bid specifications for all work within the scope of Article 3 that all successful bidders, and their subcontractors of whatever tier, become bound by, and signatory to, this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretions of the ACCC in determining which Contractors shall be awarded contracts for Project Work. It is further understood that the ACCC has sole discretion at any time to terminate, delay or suspend the work, in whole or part, on this Project.

SECTION 7. BID SPECIFICATIONS

The ACCC shall include in all bid specifications for the **Construction of the Wind Safety Training Center,** a notice advising all bidders that the work is subject to this Agreement and that all Contractors and subcontractors will be required to provide the Schedule B "Contractors Letters of Assent" as a condition of any contract award. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the ACCC in the award of contracts for work on the Project; nor shall it limit the rights of the ACCC and/or Contractors in determining which subcontractor(s) shall be awarded subcontracts for Project work.

SECTION 8. THE CONSTRUCTION PROJECT MANAGER

The ACCC will also be acting with respect to the Project as the Construction Project Manager ("Project Manager"). All references herein to the Project Manger shall be to the ACCC and all notices required to be given to the Project Manager under this Agreement shall be given to the ACCC. In addition to its rights and obligations as Owner, the ACCC shall have all rights and obligations under this Agreement as Project Manager. Notwithstanding, the ACCC may engage an outside consulting firm to support and assist the ACCC with respect to Project Management, which firm shall have all rights and obligations given to the Project Manager under this Agreement. If an outside consulting firm is retained, the ACCC will immediately notify the Unions.

SECTION 9. AVAILABILITY AND APPLICABILITY TO ALL SUCCESSFUL BIDDERS

A. The ACCC shall require in its bid specifications for all work within the scope of Article 3 that all successful bidders, and their subcontractors of whatever tier, become bound by, and signatory to, this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the ACCC or the Project Manager in determining which Contractors shall be awarded contracts for Project work. It is further understood that the ACCC has the sole discretion at any time to terminate, delay or suspend the work, in whole or in part, on this Project.

B. The Unions agree that this Agreement will be made available to, and will fully apply to any successful bidder for the Project work who becomes signatory thereto, without regard to whether that successful bidder performs work at other sites on either a union or non-union basis and without regard to whether employees of such successful bidder are, or are not, members of any unions. This Agreement shall not apply to the work of any Contractor which is performed at any location other than the Project site, as defined in Article 3, Section 1.

ARTICLE 3 – SCOPE OF THE AGREEMENT

The Project work covered by this Agreement shall be as defined and limited by the following sections of this Article.

SECTION 1. THE WORK

This Agreement applies to the construction of all on-site work at the Project, as defined in the prime contract therefore to be awarded by ACCC to the General Contractor for the Construction of the Wind Safety Training Center. This Scope of Work may be amended from time to time by ACCC to include work not performed under the original contract bid documents. The Scope of Work is confined to the on-site Project performed work contained in the scope of the General Contractor's final construction contract. In no event shall this Agreement be construed to apply to any other construction activity engaged in by ACCC, directly or indirectly or by a vendor or tenant of ACCC, at or in the vicinity of the Project site.

A summarized scope of work is attached herewith as Schedule C.

The scope of work may be amended time to time by the ACCC to include work not included under this description.

SECTION 2. EXCLUDED EMPLOYEES

The following persons are not subject to the provisions of this Agreement, even though performing work on the Project:

A. Superintendents, supervisors (excluding superintendents and general supervisors and forepersons specifically covered by a craft's Schedule A), engineers, architects, inspectors and testers (excluding divers specifically covered by a craft's Schedule A), quality control/assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, non-manual employees, and all professional, engineering, administrative and management persons;

B. Employees of ACCC or any State agency, authority or entity or employees of any municipality or other public employer;

C. Employees of any project manager or consultant engaged by the ACCC, excepting those who are performing manual, on-site construction labor who will be covered by this Agreement;

D. Employees and entities engaged in off-site manufacture, modifications, repair, maintenance, assembly, painting, handling or fabrication of project components, materials, equipment or machinery, unless such offsite operations are covered by the New Jersey Prevailing wage Act by being dedicated exclusively to the performance of the public works contract or building project and are adjacent to the site of work, or involved in deliveries to and from the Project site, excepting local deliveries of all major construction materials including, but not limited to, fill, ready mix, and asphalt which are covered by this Agreement;

E. Employees of the Contractors, excepting those performing manual, on-site construction

labor covered by this Agreement;

F. Employees engaged in on-site equipment warranty;

G. Employees engaged in geophysical testing (whether land or water) other than boring for core samples;

H. Employees engaged in laboratory or specialty testing or inspections;

I. Employees engaged in ancillary Project work performed by third parties such as electric utilities, gas utilities, telephone utilities companies, and railroads;

SECTION 3. NON-APPLICATION TO CERTAIN ENTITIES

This Agreement shall not apply to the parents, affiliates, subsidiaries, or other joint or sole ventures of the Owner, the Project Manager, or any Contractors which do not perform work at this Project Site. It is agreed, for the purposes of this Agreement only, that this Agreement does not have the effect of creating any joint employment, single employer or alter ego status between the ACCC, the Project Manager and/or any Contractor. The Agreement shall further not apply to the ACCC, its Project Management firm, Clerk of the Works, or any other state or ACCC agency, authority, or other municipal or public entity, and nothing contained herein shall be construed to prohibit or restrict the ACCC or its employees, or the employees of any other state authority, agency or entity from performing on or off-site work related to the Project. As the contracts which comprise the Project work are completed and accepted, the Agreement shall not have further force or effect on such items or areas except where inspections, additions, repairs, modifications, check-out and/or warranty work are assigned in writing (copy to Local Union involved) to the Contractor(s) for performance under the terms of this Agreement and per Schedule B - "Contractors Letters of Assent."

ARTICLE 4 – UNION RECOGNITION AND EMPLOYMENT

SECTION 1. PRE-HIRE RECOGNITION

The Contractors recognize the signatory Unions as the sole and exclusive bargaining representatives of all craft employees who are performing on-site Project work within the scope of this Agreement as defined in Article 3.

SECTION 2. UNION REFERRAL

A. The Contractors agree to hire Project craft employees covered by this Agreement through the job referral systems and hiring halls (where the referrals meet the qualifications set forth in items 1, 2, and 4 subparagraph B) established in the Local Unions' area collective bargaining agreements (attached as Schedule A to this Agreement). Notwithstanding this, the Contractors shall have sole rights to determine the competency of all referrals; the number of employees required (except with regard to pile-driving); the selection of employees to be laid-off (subject to the applicable

procedures in Schedule A for permanent and/or temporary layoffs and except as provided in Article 5, Section 3); and the sole right to reject any applicant referred by a Local Union, subject to the show-up payments required in the applicable Schedule A. In the event that a Local Union is unable to fill any request for qualified employees within a 48-hour period after such requisition is made by the Contractor (Saturdays, Sundays and holidays excepted), the Contractor may employ qualified applicants from another competent source. In the event that the Local Union does not have a job referral system, the Contractor shall give the Local Union first preference to refer applicants, subject to the other provisions of this Article. The Contractor shall notify the Local Union of the Project, craft employees hired within its jurisdiction from any source other than referral by the Union.

B. Following the employment of the first employee in each craft under Schedule A or the procedure set forth above in paragraph A, a Contractor may request by name, and the Local will honor, referral of persons who have applied to the Local for Project work and who meet the following qualifications as determined by a Committee of 3 designated, respectively, by the applicable Local Union, the ACCC and a mutually selected third party or, in the absence of agreement, the permanent arbitrator (or designee) designated in Article 7:

1) Possess any license required by New Jersey law for the Project work to be performed;

2) Have worked a total of at least 1,000 hours in the Construction craft during the prior 3 years;

3) Were on the Contractor's active payroll for at least 60 out of the 180 calendar days prior to the contract award; and

4) Have demonstrated ability to safely perform the basic function of the applicable trade.

No more than 12 per centum of the employees covered by this Agreement, per Contractor by craft, shall be hired through the special provisions above (any fraction shall be rounded to the next highest whole number).

Certified MBE/WBE contractor may request from the Workforce Coordinator, through the ACCC, an exception to, and waiver of, the above per centum limitation upon the number of its employees to be hired through the special provision of Section 2.b above. This exception is based upon hardship and demonstration by the Contractor that the Project work would be the Contractor's only job and that it would be obliged to lay off qualified minority and female employees in its current workforce moving from the last job. The exception and waiver are also conditioned upon the employees meeting the qualifications as set forth in Section 2.b, above.

SECTION 3. NON-DISCRIMINATION IN REFERRALS

The Unions represent that their hiring halls and referral systems will be operated in a non-

discriminatory manner and in full compliance with all applicable federal, state and local laws and regulations, which require equal employment opportunities. Referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements and shall be subject to such other conditions as are established in this Article. No employment applicant shall be discriminated against by any referral system or hiring hall because of the applicant's union membership, or lack thereof.

SECTION 4. MINORITY AND FEMALE REFERRALS

In the event a Union either fails, or is unable, to refer qualified minority or female applicants in percentages equaling Project affirmative action goals as set forth in the ACCC's bid specifications, the Contractor may employ qualified minority or female applicants from any other available source as Apprentice Equivalents. Apprentice Equivalents will have completed a Department of Labor ("DOL") approved training program, applied to take a construction Apprenticeship test, and will be paid at not less than the applicable equivalent Apprentice rate. With the approval of the Local Administrative Committee (LAC), experience in construction related areas may be accepted as meeting the above requirements.

SECTION 5. CROSS AND QUALIFIED REFERRALS

The Unions shall not knowingly refer to a Contractor an employee then employed by another Contractor working under this Agreement. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled and qualified craft employees to fulfill the requirements of the Contractor.

SECTION 6. UNION DUES/WORKING ASSESMENTS

Nothing in this Agreement requires employees to join a union or pay dues or fees to a union as a condition of working on the covered project. This Agreement is not, however, intended to supersede independent requirements in applicable local union agreements as to contractors that are otherwise signatory to those agreements and as to employees of such employers performing covered work.

SECTION 7. CRAFT FOREPERSONS AND GENERAL FOREPERSONS

The selection of craft forepersons and/or general forepersons and the number of forepersons required shall be solely the responsibility of the Contractor except where otherwise provided by specific provisions of an applicable Schedule A collective bargaining agreement. All forepersons shall take orders exclusively from the designated Contractor representatives. Craft forepersons shall be designated as working forepersons at the request of the Contractor, except when an existing local Collective Bargaining Agreement prohibits a foreperson from working when the crafts-persons he is leading exceed a specified number.

ARTICLE 5 – UNION REPRESENTATIONS

SECTION 1. LOCAL UNION REPRESENTATIVE

Each Local Union representing on-site Project employees shall be entitled to designate in writing (with copies to the Contractors involved and the ACCC and Project Management Firm) one representative, and the Business Manager, who shall be afforded access to the Project. Such representatives shall fully comply with the visitor, safety and security of the Project.

SECTION 2. STEWARDS

A) Each Local Union shall have the right to designate a working journey person as a Steward and an alternate, and shall notify the Contractor and PM of the identity of the designated Steward (and alternate) prior to the assumption of such duties. Stewards shall not exercise supervisory functions and will receive the regular rate of pay for the craft classifications. There will be no non-working Stewards on the Project.

B) In addition to their work as an employee, the Steward shall have the right to receive complaints or grievances and to discuss and assist in their adjustment with the Contractor's appropriate supervisor. Each Steward shall be concerned with the employees of the Steward's Contractor and, if applicable, subcontractors of that Contractor, but not with the employees of any other Contractor. The Contractor will not discriminate against the Steward in the proper performance of Union duties.

C) The Stewards shall not have the right to determine when overtime shall be worked, or who shall work overtime, except pursuant to a Schedule A provision providing procedures for the equitable distribution of overtime.

SECTION 3. LAYOFF OF A STEWARD

Contractors agree to notify the appropriate Union 24 hours prior to the layoff of a Steward, except in cases of discipline or discharge for just cause. If a Steward is protected against layoff by a Schedule A, such provisions shall be recognized to the extent the Steward possesses the necessary qualifications to perform the work required. In any case in which a Steward is discharged or disciplined for just cause, the Local Union involved shall be notified immediately by the Contractor.

ARTICLE 6 – MANAGEMENT'S RIGHTS

SECTION 1. RESERVATION OF RIGHTS

Except as expressly limited by a specific provision of this Agreement, Contractors retain full and exclusive authority for the management of their Project operations including, but not

limited to: the right to direct the work force, including determination as to the number to be hired and the qualifications therefore; the promotion, transfer, layoff of its employees; or the discipline or discharge for just cause of its employees; the assignment and schedule of work; the promulgation of reasonable Project work rules; and, the requirement, timing and number of employees to be utilized for overtime work. No rules, customs, or practices, which limit or restrict productivity or efficiency of the individual, as determined by the Contractors and/or joint working efforts with other employees shall be permitted or observed.

SECTION 2. MATERIALS, METHODS & EQUIPMENT

There shall be no limitations or restriction upon the Contractors choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials, tool, or other labor-saving devices. Contractors may, without restriction, install or use materials, supplies or equipment regardless of their source. The on-site installation or application of such items shall be performed by the craft having jurisdiction over such work; provided, however, it is recognized that other personnel having special qualifications may participate, in a supervisory capacity, in the installation, check-out or testing of specialized or unusual equipment or facilities as designated by the Contractor. Notwithstanding the foregoing statement of contractor rights, prefabrication issues relating to work traditionally performed at the job site shall be governed pursuant to the terms of the applicable Schedule A. There shall be no restrictions as to work, which is performed off-site for the Projects, except for work done in a fabrication center, tool yard, or batch plant dedicated exclusively to the performance of work on the Project, and located adjacent to the "site of work".

ARTICLE 7 – WORK STOPPAGES AND LOCKOUTS

SECTION 1. NO STRIKES-NO LOCKOUT

There shall not be strikes, sympathy strikes, picketing, work stoppages, slowdowns, hand billing, demonstrations or other disruptive activity at the Project for any reason by any Union or employee against any Contractor or employer while performing work at the Project. There shall be no other Union, or concerted or employee activity which disrupts or interferes with the operation of the existing free flow of traffic in the project area. Failure of any Union or employee to cross any picket line established by any union, signatory or non-signatory to this Agreement, or the picket or demonstration line of any other organization, at or in proximity to the Project site is a violation of this Article. There shall be no lockout at the Project by any signatory Contractor. Contractors and Unions shall take all steps necessary to ensure compliance with this Section 1 and to ensure uninterrupted construction and the free flow of traffic in the project area for the duration of this Agreement.

SECTION 2. DISCHARGE FOR VIOLATION

A Contractor may discharge any employee violating Section 1, above, and any such employee will not be eligible thereafter for referral under this Agreement for a period of 100 days.

SECTION 3. NOTIFICATION

If a Contractor contends that any Union has violated this Article, it will notify the appropriate district or area council of the Local Union involved advising of such fact, with copies of the notification to the Local Unions and South Jersey Building and Construction Trades Council ("BTC"). The district or area council, and the BTC shall each instruct, order and otherwise use their best efforts to cause the employees, and/or Local Unions to immediately cease and desist from any violation of this Article. A district or area council, or the BTC complying with these obligations shall not be liable for the unauthorized acts of a Local Union or its members.

SECTION 4. EXPEDITED ARBITRATION

Any Contractor or Union alleging a violation of Section 1 of this Article may utilize the expedited procedure set forth below (in lieu of, or in addition to, any actions at law or equity) that may be brought.

A. A party invoking this procedure shall notify JJ Pierson, Jr., Esq., The Arbitration Centre, 8 Fox Hunt Road, Box 604, New Vernon, NJ 07976, phone 973-359-8100, fax 973-359-8161 who shall serve as Arbitrator under this expedited arbitration procedure. Copies of such notification will be simultaneously sent to the alleged violator and, if a Local Union is alleged to be in violation, its International, the ACCC, the PM, the BTC, and the Contractor involved.

B. The Arbitrator shall thereupon, after notice as to the time and place to the Contractor, the Local Union involved, the BTC, and the PM, hold a hearing within 48 hours of receipt of the notice invoking the procedure if it is contended that the violation still exists. The hearing will not, however, be scheduled for less than 24 hours after the notice to the ACCC or area council required by Section 3 above.

C. All notices pursuant to this Article may be by telephone, telegraph, hand delivery, or fax, confirmed by overnight delivery, to the arbitrator, Contractor or Union involved. The hearing may be held on any day including Saturdays or Sundays. The hearing shall be completed in one session, which shall not exceed 8 hours duration (no more than 4 hours being allowed to either side to present their case, and conduct their cross examination) unless otherwise agreed. A failure of any Union or Contractor to attend the hearing shall not delay the hearing of evidence by those present or the issuance of an award by the Arbitrator.

D. The sole issue at the hearing shall be whether a violation of Section 1, above, occurred. If a violation is found to have occurred, the Arbitrator shall issue a Cease and Desist Award restraining such violation and serve copies on the Contractor and Union involved. The Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages, which issue is reserved solely for court proceedings, if any. The Award shall be issued in

writing within 3 hours after the close of the hearing, and may be issued without an Opinion. If any involved party desires an Opinion, one shall be issued within 15 calendar days, but its issuance shall not delay compliance with, or enforcement of, the Award.

E. An Award issued under this procedure may be enforced by any court of competent jurisdiction upon the filing of the Agreement together with the Award. Notice of the filing of such enforcement proceedings shall be given to the Union or Contractor involved. In any court proceeding to obtain a temporary or preliminary order enforcing the arbitrator's Award as issued under this expedited procedure, the involved Union and Contractor waive their right to a hearing and agree that such proceedings may be ex parte, provided notice is given to opposing counsel. Such agreement does not waive any party's right to participate in a hearing for a final court order of enforcement or in any contempt proceeding.

F. Any rights created by statue or law governing arbitration proceedings which are inconsistent with the procedure set forth in this Article, or which interfere with compliance thereto, are hereby waived by the Contractors and Unions to whom they accrue.

G. The fees and expenses of the Arbitrator shall be equally divided between the involved Contractor and Union.

SECTION 5. ARBITRATION OF DISCHARGES FOR VIOLATION

Procedures contained in Article 9 shall not be applicable to any alleged violation of this Article, with the single exception that an employee discharged for violation of Section1, above, may have recourse to the procedures of Article 9 to determine only if the employee did, in fact, violate the provisions of Section 1 of this Article; but not for the purpose of modifying the discipline imposed where a violation is found to have occurred.

ARTICLE 8. – LOCAL ADMINISTRATIVE COMMITTEE (LAC)

SECTION 1. THE LOCAL ADMINISTRATIVE COMMITTEE

The Local Administrative Committee (LAC) will meet on a regular basis to:

A. Implement and oversee this Agreement's procedures and initiatives;

B. Monitor the effectiveness of this Agreement; and

C. Identify opportunities to improve efficiency and work execution.

SECTION 2. COMPOSITION

The LAC will be co-chaired by the President of the BTC or his designee, and a

designated official of the ACCC. It will be comprised of representatives of the local union's signatory to this Agreement and representatives of the ACCC's Project Management firm and other contractors on the Project.

ARTICLE 9. – GRIEVANCE AND ARBITRATION PROCEDURE

SECTION 1. PROCEDURE FOR RESOLUTION OR GRIEVANCES

Any question, dispute or claim arising out of, or involving the interpretation or application of this Agreement (other than jurisdictional disputes or alleged violation of Article 7, Section 1) shall be considered a grievance and shall be resolved pursuant to the exclusive procedure of the steps described below; provided, in all cases, that the question, dispute or claim arose during the term of this Agreement.

Step 1:

A. When any employee covered by this Agreement feels aggrieved by a claimed violation of this Agreement, the employee shall, through the Local Union business representative or job steward give notice of the claimed violation to the work site representative of the involved Contractor. To be timely, such notice of the grievance must be given within 7 calendar days after the act, occurrence, or event giving rise to the grievance, or after the act, occurrence or event became known or should have become known to the Union. The business representative of the Local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter within 7 calendar days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party, may, within seven (7) calendar days thereafter, pursue Step 2 of the grievance procedure by serving the involved Contractor with written copies of the grievance setting forth a description of the claimed violation, the date on which the grievance occurred, the provisions of the Agreement alleged to have been violated. Grievances and disputes settled at Step 1 are non-precedential except as to the specific Local Union, employee and Contractor directly involved, unless the settlement is accepted in writing, by the Contractor, as creating a precedent; and

B. Should any signatory to this Agreement have a dispute (excepting jurisdictional disputes or alleged violations of Article 7, Section 1) with any other signatory to this Agreement and, if after conferring, a settlement is not reached within 7 calendar days, the dispute shall be reduced to writing and proceed to Step 2 in the same manner as outlined in sub-paragraph (a) for the adjustment of grievances on behalf of employees.

Step 2:

The Business Manager or designee of the involved Local Union, together with representatives of the BTC and the involved Contractor, shall meet in Step 2 within 5 calendar days of the written grievance to arrive at a satisfactory settlement.

Step 3:

A. If the grievance shall have been submitted but not resolved in Step 2, any of the participating Step 2 entities may, within fourteen (14) calendar days after the initial Step 2 meeting, submit the grievance in writing (with copies to other participants) to the next available arbitrator of the panel of Arbitrators consisting of Arbitrator JJ Pierson, Gary Kendellen, and Wellington Davis, who shall act as the Arbitrator under this procedure. The Labor Arbitration Rules of the American Arbitration Association shall govern the conduct of the arbitration hearing, at which all Step 2 participants shall be parties. The decision of the Arbitrator shall be final and binding on the involved Contractor, Local Union and employees. The fees and expenses of such arbitration shall be borne equally by the involved Contractor and Local Union.

B. Failure of the grieving party to adhere to the time limits set forth in this Article shall render the grievance null and void. These time limits may be extended only by written consent of the PM, involved Contractor and involved Local Union at the particular step where the extension is agreed upon. The Arbitrator shall have authority to make decisions only on the issues presented to him and shall not have the authority to change, add to, delete or modify any provision of this Agreement.

SECTION 2. LIMITATION AS TO RETROACTIVITY

No arbitration decision or award may provide retroactivity of any kind exceeding thirty (30) calendar days prior to the date of service of the written grievance on the Project Manager, the ACCC and the involved Contractor or Local Union.

SECTION 3. PARTICIPATION BY PROJECT MANAGER

The Project Manager shall be notified by the involved Contractor of all actions at Steps 2 and 3 and, at its election, may participate in full in all proceedings at these Steps, including Step 3 arbitration.

ARTICLE 10 – JURISDICTIONAL DISPUTES

SECTION 1. NO DISTRUPTIONS

There will be no strikes, sympathy strikes, work stoppages, slowdowns, picketing or other disruptive activity of any kind arising out of any jurisdictional dispute. Pending the resolution of the dispute, the work shall continue uninterrupted and as assigned by the Contractor. No jurisdictional dispute shall excuse a violation of Article 7.

SECTION 2. ASSIGNMENT

A. There shall be a mandatory pre-job markup/assignment meeting prior to the commencement of any work. Attending such meeting shall be designated representatives of the Union signatories to this Agreement, the PM, and the involved

Contractors. Best efforts will be made to schedule the pre-job meeting in a timely manner after Notice to Proceed is issued but not later than 30 days prior to the start of the Project.

B. All project construction work assignments shall be made by the Contractor according to the criteria set forth in Section 3, Subsection D 1-3.

C. When a Contractor has made an assignment of work, he shall continue the assignment without alternation unless otherwise directed by an arbitrator or there is an agreement between the National or International Unions involved. Claims of a change of assignment shall be processed in accordance with Article 1 of the Procedural Rules of the Plan for the Settlement of Jurisdictional disputes in the Construction Industry ("the Plan").

D. In the event that a Union involved in the change of original assignment dispute is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to process a case through the Plan, the parties shall mutually select one of the following Arbitrators: Arbitrator JJ Pierson, Arbitrator Gary Kendellen, or Arbitrator Wellington Davis, and submit the dispute directly to the Arbitrator. The selected Arbitrator shall determine whether the case requires a hearing or may be decided upon written submission. In rendering his determination on whether there has been a change of original assignment, the Arbitrator shall be governed by the following:

1) The Contractor who has the responsibility for the performance and installation shall make a specific assignment of the work which is included in his contract to a particular union(s). For instance, if Contractor A subcontracts certain work to Contractor B, the Contractor B shall have the responsibility for making the specific assignments for the work included in his contract. If Contractor B, in turn shall subcontract certain work to Contractor C, then Contractor C shall have the responsibility for making the specific assignment for the work included in his contract. After work has been so assigned, each assignment will be maintained even though the assigning Contractor is replaced and such work is subcontracted to another Contractor. It is a violation of the Agreement for the Contractor to hold up disputed work or shut down a project because of a jurisdictional dispute.

2) When a Contractor has made an assignment of work, he shall continue the assignment without alteration unless otherwise directed by an Arbitrator or there is an agreement between the National or International Unions involved.

    a. Unloading and/or handling of materials to stockpile or storage by a trade for the convenience of the responsible Contractor when his employees are not on the job site, or in an emergency situation,

shall not be considered to be an original assignment to the trade.

b. Starting of work by a trade without a specific assignment by an authorized representative of the responsible Contractor shall not be considered an original assignment of that trade, provided that the responsible Contractor, or his authorized representative, promptly, and in any event, within eight (8) working hours following the start of the work, takes positive steps to stop further unauthorized performance of the work by that trade.

SECTION 3. PROCEDURE FOR SETTLEMENT OF DISPUTES

A. Any Union having a jurisdictional dispute with respect to Project work assigned to another Union will submit through its International the dispute in writing to the Administrator of the Plan within 72 hours and send a copy of the letter to the other Union involved, the Contractor involved, the General Contractor, the BTC, and the district or area councils of the unions involved. Upon receipt of a dispute letter from any union, the Administrator will invoke the procedures set forth in the Plan to resolve the jurisdictional dispute. The jurisdictional dispute letter shall contain the information described in Article IV of the Procedural Rules of Plan.

B. Within five (5) calendar days of receipt of the dispute letter, there shall be meeting of the General Contractor, the Contractor involved, the Local Unions involved and designees of the BTC and the district or area councils of the Local Unions involved for the purpose of resolving the jurisdictional dispute.

C. In order to expedite the resolution of jurisdictional disputes, the parties have agreed in advance to mutually select one of the following designated Arbitrators: Arbitrator JJ Pierson, Arbitrator Andy Douglas or Arbitrator Richard K. Henft to hear all unsolved jurisdictional disputes arising under this Agreement. All other rules and procedures of the Plan shall be followed. If none of the three Arbitrators is not available to hear the dispute within the time limits of the Plan, the Plan's arbitrator selection process shall be utilized to select another arbitrator.

D. In the event that a Union involved in the dispute is an affiliate of a National or International Union that is not affiliated with the National Building and Construction Trades Council and does not wish to process cases through the Plan as described in paragraphs A-C above, the parties to the dispute shall mutually select one of the following Arbitrators: Arbitrator JJ Pierson, Arbitrator Gary Kendellen, or Arbitrator Wellington Davis to hear the dispute and shall submit the dispute directly to the selected arbitrator. The time limits for submission and processing disputes shall be the same as provided elsewhere in this Section. The selected Arbitrator shall schedule the hearing within seven (7) business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators will be selected to hear the case unless all parties to the dispute agree to waive the seven (7) day time limit. In rendering his decision, the Arbitrator shall determine:

1) First whether a previous agreement of record or applicable agreement, including a disclaimer agreement, between the National and International Unions to the dispute governs;

2) Only if the Arbitrator finds that the dispute is not covered by an appropriate or applicable agreement of record or agreement between the crafts to the dispute, he shall then consider the established trade practice in the industry and prevailing practice in the locality where there is a previous decision of record governing the case, the Arbitrator shall give equal weight to such decision of record, unless the prevailing practice in the locality in the past ten (10) years favors one craft. In that case, the Arbitrator shall base his decision on the prevailing practice in the locality. Except, that if the Arbitrator finds that a craft has improperly obtained the prevailing practice in the locality through raiding, the undercutting of wages or by the use of vertical agreements, the Arbitrator shall rely on the decision of record and establish trade practice in the industry rather than the prevailing practice in the locality.

3) Only if none of the criteria is found to exist, the Arbitrator shall then consider that because of efficiency, cost or continuity and good management are essential to the wellbeing of the industry, the interest of the consumer or the past practices of the employer shall not be ignored. The Arbitrator shall set forth the basis of his decision and shall explain his findings regarding the applicability of the above criteria. If lower-ranked criteria are relied upon, the Arbitrator shall explain why a higher- ranked criteria were not deemed applicable. The Arbitrator's decision shall apply to the job in dispute.

Each party to the arbitration shall bear its own expense for the arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

E. The Arbitrator shall render a short-form decision within five (5) days of the hearing based upon the evidence submitted at the hearing, with a written decision to follow within thirty (30) days of the close of hearing.

F. This Jurisdictional Dispute Resolution Procedure will only apply to work performed by Local Unions that represent workers employed on the Project.

G. Any Local Union involved in a jurisdictional dispute on this Project shall continue working in accordance with Section 2 above and without disruption of any kind.

SECTION 4. AWARD

Any award rendered pursuant to this Article and the Plan shall be final and binding on

the disputing Local Unions and the involved Contractor on this Project only and may be enforced in accordance with the provisions of Article VII of the Plan. Any award rendered pursuant to the alternate procedures of this Article shall be final and binding on the disputing Local Unions and the involved Contractor on this Project only, and may be enforced in any court of competent jurisdiction. Such award or resolution shall not establish a precedent on any other construction work not covered by this Agreement. In all disputes under this Article, the General Contractor and the involved Contractors shall be considered parties in interest.

SECTION 5. LIMITATIONS

The Arbitrator shall have no authority to assign work to a double crew, that is, to more employees than the minimum required by the Contractor to perform the work involved; nor to assign work to employees who are not qualified to perform the work involved; nor to assign work being performed by non-union employees to union employees. This does not prohibit the establishment, with the agreement of the involved Contractor, of composite crews where more than 1 employee is needed for the job. The aforesaid determinations shall decide only to whom the disputed work belongs.

SECTION 6. NO INTERFERENCE WITH WORK

A. There shall be no interference or interruption of any kind with the work of the Project while any jurisdictional dispute is being resolved. The work shall proceed as assigned by the Contractor until finally resolved under the applicable procedure of this Article. The award shall be confirmed in writing to the involved parties. There shall be no strike, work stoppage or interruption in protest any such award. Any Claims of a violation of this section shall be submitted and processed in accordance with the impediment to job progress provisions of the Plan.

B. In the event a Union alleged to have engaged in an impediment to job progress is an affiliate of a National or International Union that is not affiliate with the Building and Construction Trades Department and does not wish to have the impediment to job progress charge processed through the Plan, the parties to the dispute shall mutually select one of the three Arbitrators designated in this Article to hear the dispute. The selected Arbitrator shall schedule the hearing within two (2) business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators shall be selected by the parties to hear the case unless all parties to the dispute agree to waive the two (2) day time limit. The sole issue at the hearing shall be whether or not a violation of this Section has in fact occurred, and the Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages. The Arbitrator's decision shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without an opinion. If any party desires an opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the decision. The Arbitrator may order cessation of the violation of this Section and other appropriate relief, and such decision shall be served on all parties by facsimile upon issuance. Each party to the arbitration shall bear its own expense for the

arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

ARTICLE 11 – WAGES AND BENEFITS

SECTION 1. CLASSIFICATION AND BASE HOURLY RATE

All employees covered by this Agreement shall be classified in accordance with the work performed and paid the base hourly wage rates for those classifications as specified in the attached Schedule A, as amended during this Agreement. Recognizing, however, that special conditions may exist or occur on the Project, the parties, by mutual agreement may establish rates and/or hours for one or more classifications, which may differ from Schedule A. Parties to such agreements shall be the Contractors involved, the involved Local Unions and the BTC.

SECTION 2. EMPLOYEE BENEFIT FUNDS

A. The Contractors agree to pay contributions on behalf of all employees covered by this Agreement to the established employee benefit funds in the amounts designated in the appropriate Schedule A; provided, however, that the Contractor and the Union agree that only such bona fide employee benefits as are explicitly required under N.J.S.A. 34:11-56.30 of the New Jersey State Labor Law shall be included in this requirement and paid by the Contractor on this Project. Bona fide jointly trusted fringe benefit plans established or negotiated through collective bargaining during the life of this Agreement may be added if similarly protected under N.J.S.A. 34:11-56.30. Contractors shall not be required to contribute to non-N.J.S.A. 34:11-56.30 benefits, trusts or plans.

B. The Contractor agrees to be bound by the written terms of the legally established Trust Agreements specifying the detailed basis on which payments are to be paid into, and benefits paid out of, such Trust Funds but only with regard to work done on this Project and only for those employees to whom this Agreement requires such benefit Payments.

C. Prior to the Project Manager or any Contractor making any payment to a Contractor or sub-contractor, the Project Manager or Contractor shall verify that the Contractor or sub-contractor has made contributions in full to the respective employee benefit funds. The Project Manager or Contractor will obtain this verification in writing from the Contractor or sup-contractor prior to making any payment to a Contractor or sub-contractor.

D. Should any Contactor or sub-contractor become delinquent in the payment of contributions to the fringe benefit funds, then the sub-contractor at the next higher tier, or upon notice of the delinquency claim from the Union or the Funds, agrees to withhold from the sub-contractor such disputed amount from the next advance, or installment payment for work performed until the dispute has been resolved.

ARTICLE 12 – HOURS OF WORK, PREMIUM PAYMENTS, SHIFTS AND HOLIDAYS

SECTION 1. WORK WEEK AND WORK DAY

A. The standard work week shall consist of forty (40) hours of work at straight time rates per one of the following schedules:

1. Five Day Work Week: Monday-Friday, 5 days, 8 hours plus ½ hour unpaid lunch period each day.
2. Four Day Work Week: Monday-Thursday, 4 Days, 10 hours plus ½ hour unpaid lunch period each day.

B. The Day Shift shall commence between the hours of 6:00 am and 9:00am and shall end between the hours of 2:30 pm and 7:30 pm. Starting and quitting times shall occur at the employees' place of work as may be designated by the Contractor.

C. Scheduling: The Contactor shall have the option of scheduling either a five-day work week, or a four-day work week (when mutually agreed upon on a craft-by-craft basis). The Contractor shall also have the option to set the work day hours consistent with Project requirements, the Project schedule, and minimization of interference with site operations traffic flow. When conditions beyond the control of the Contractor, such as severe weather, power failure, fire or natural disaster, prevent the performance of Project work on a regularly scheduled work day, the Contractor may, with mutual agreement of the Local Union on a craft-by-craft basis, schedule Friday (where on 4 day 10 hours) during the calendar week in which a workday was lost, at straight time pay; providing the employees involved work a total of 40 hours or less during that work week.

D. Notice: Contractors shall provide not less than five (5) days prior notice to the Local Union involved as to the work week and work hours schedules to be worked or such lesser notice as may be mutually agreed upon.

SECTION 2. OVERTIME

Overtime pay for hours outside of the standard work week and work day, described in Article 12 Section 1 above, shall be paid in accordance with the applicable Schedule A. There will be no restriction upon the Contractor's scheduling of overtime or the non-discriminatory designation of employees who shall be worked, except as noted in Article 5, Section 2. There shall be no pyramiding of overtime pay under any circumstances. The Contractor shall have the right to schedule work so as to minimize overtime.

SECTION 3. SHIFTS

A. Flexible Schedules: Scheduling of shift work shall remain flexible in order to meet Project schedules and existing Project conditions including the minimization of interference with ACCC operations. It is not necessary to work a day shift in order

to schedule a second shift. Shifts must be worked a minimum of five consecutive work days, must have prior approval of the ACCC and must be scheduled with no less than five (5) work days notice to the Local Union.

B. Second Shift: The second shift (starting between 2 pm and 8 pm) shall consist of 8 hours work (or 10 hours of work) for an equal number of hours pay at the straight time rate plus 15% in lieu of overtime and exclusive of a ½ hour unpaid lunch period.

C. Flexible Starting Times: Shift starting times will be adjusted by the Contractor as necessary to fulfill Project requirements subject to the notice requirements of Paragraph A.

D. Four Tens: When working a four-day work week, the standard work day shall consist of ten (10) hours work for ten (10) hours of pay at the straight time rate exclusive of an unpaid1/2 hour meal period and regardless of the starting time. This provision is applicable to night shifts only, and such night shifts are subject to the shift differential in paragraph B above.

E. It is agreed that when project circumstances require a deviation from the above shifts, the involved Unions and Contractors shall adjust the starting times of the above shifts or establish shifts which meet the project requirements. It is agreed that neither party will unreasonably withhold their agreement.

SECTION E. HOLIDAYS

A. Schedule: There shall be eight (8) recognized holidays on the Project:

New Year's Day	Labor Day
Presidents Day	Veterans Day
Memorial Day	Thanksgiving Day
Fourth of July	Christmas Day

Work shall be scheduled on Good Friday pursuant to the craft's Schedule A.

All of the above holidays shall be observed on the dates designated by New Jersey State Law. In the absence of such designations, they shall be observed on the calendar date except those holidays which occur on Sunday shall be observed on the following Monday. Holidays falling on Saturday are to be observed on the preceding Friday.

B. Payment: Regular holiday pay, if any, and/or premium pay for work performed on such a recognized holiday shall be in accordance with the applicable Schedule A.

C. Exclusivity: No holidays other than those listed in Section 4.A above, shall be recognized nor observed except in Presidential Election years when Election Day is a recognized holiday.

SECTION 5. REPORTING PAY

A. Employees who report to work location pursuant to regular schedule and who are not provided with work or whose work is terminated early by a Contractor, for whatever reason, shall receive minimum reporting pay in accordance with the applicable Schedule A.

B. When an employee, who has completed his/her scheduled shift and left the Project site, is "called back" to perform special work of a casual, incidental or irregular nature, the employee shall receive pay for actual hours worked with a minimum guarantee, as may be required by the applicable Schedule A.

C. When an employee leaves the job or work location of his/her own volition or is discharged for cause or is not working as result of the Contractor's invocation of Section 7 below, they shall be paid only for the actual time worked.

D. Except as specifically set forth in this Article there shall be no premiums, bonuses, hazardous duty, high time or other special payments of any kind.

E. There shall be no pay for time not actually worked except as specifically set forth in this Agreement and except where an applicable Schedule A requires a full weeks pay for forepersons.

SECTION 6. PAYMENT OF WAGES

A. Payday: Payment shall be made by check, drawn on a New Jersey bank with branches located within commuting distance of the job site. Paychecks shall be issued by the Contractor at the job site by 10 AM on Thursdays. In the event that the following Friday is a bank holiday, paychecks shall be issued on Wednesday of that week. Not more than three (3) days wages shall be held back in any pay period. Paycheck stubs shall contain the name and business address of the Contractor, together with an itemization of deductions from gross wages.

B. Termination: Employees who are laid-off or discharged for cause shall be paid in full for that which is due them at the time of termination. The Contractors shall also provide the employee with a written statement setting forth the date of lay off or discharge.

SECTION 7. EMERGENCY WORK SUSPENSION

A Contractor may, if considered necessary for the protection of life and/or safety of employees or others, suspend all or a portion of Project Work. In such instances, employees will be paid for actual time worked; provided, however, that when a Contractor requests that employees remain at the job site available for work, employees will be paid for "stand-by" time at their hourly rate of pay. The same rules will apply in the case that the Construction Manager determines that a part or all of the Project work must be suspended if considered necessary for

the protection of life and/or safety of employees or others.

SECTION 8. INJURY/DISABILITY

An employee who, after commencing work, suffers a work-related injury or disability while performing work duties, shall receive no less than 8 hours wages for that day. Further, the employee shall be rehired at such time as the employee is able to return to duties provided there is still work available on the Project for which the employee is qualified and able to perform.

SECTION 9. TIME KEEPING

A Contractor may utilize brassing or other systems to check employees in and out. Each employee must check in and out. The Contractor will provide adequate facilities for checking in and out in an expeditious manner.

SECTION 10. MEAL PERIOD

A Contractor shall schedule an unpaid period of not more than ½ hour duration at the work location between the 3rd and 5th hour of the scheduled shift. A Contractor may, for efficiency of operation, establish a schedule which coordinates the meal periods of two or more crafts. If an employee is required to work through the meal period, the employee shall be compensated in a manner established in the applicable Schedule A.

SECTION 11. BREAK PERIODS

There will be no rest periods, organized coffee breaks or other non-working time established during working hours. Individual coffee containers will be permitted at the employee's work location. Local area practice will prevail for coffee breaks that are not organized.

ARTICLE 13 – APPRENTICES

SECTION 1. RATIOS

Recognizing the need to maintain continuing supportive programs designed to develop adequate numbers of competent workers in the construction industry and to provide craft entry opportunities for minorities, women and economically disadvantaged non-minority males, Contractors will employ apprentices in their respective crafts to perform such work as is within their capabilities and which is customarily performed by the craft in which they are indentured. Contractors may utilize apprentices and such other appropriate classifications as are contained in the applicable Schedule A in a ratio not to exceed 25% (twenty-five percent) of work force by craft (without regard to whether a lesser ratio is set forth in Schedule A), unless the applicable Schedule A provide for a higher percentage. Apprentices and such other classifications as are appropriate shall be employed in a manner consistent with the provisions of the appropriate Schedule A.

SECTION 2. DEPARTMENT OF LABOR

To assist the Contractors in attaining a maximum effort on this Project, the Unions agree to work in close cooperation with, and accept monitoring by, the New Jersey State and Federal Departments of Labor to ensure that minorities, women, or economically disadvantaged individuals are afforded opportunities to participate in apprenticeship programs which result in the placement of apprentices on this Project. To further ensure that this Contractor effort is attained, up to 50% (fifty percent) of the apprentices placed on this Project should be first year, minority, women or economically disadvantaged apprentices. The Local Unions will cooperate with the Contractor request for minority, women or economically disadvantaged referrals to meet this Contractor effort.

ARTICLE 14 – SAFETY PROTECTION OF PERSON AND PROPERTY

SECTION 1. SAFETY REQUIREMENTS

Each Contractor will ensure that applicable OSHA requirements and other safety requirements set forth in the contract documents are at all times maintained on the Project and the employees and Unions agree to cooperate fully with these efforts. Employees must perform their work at all times in a safe manner and protect themselves and the property of the Contractor and the Owner from injury or harm. Failure to do so will be grounds for discipline, including discharge

SECTION 2. CONTRACTOR RULES

Employees covered by this Agreement shall at all times be bound by the reasonable safety, security, and visitor rules as established by the Contractors and the PM for this Project. Such rules will be published and posted in conspicuous places throughout the Project.

SECTION 3. INSPECTIONS

The Contractors, ACCC, Architect and Project Manager retain the right to inspect incoming shipments of equipment, apparatus, machinery and construction materials of every kind.

ARTICLE 15 – NO DISCRIMINATION

SECTION 1. COOPERATIVE EFFORTS

The Contractors and Unions agree that they will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or age in any manner prohibited by law or regulation. It is recognized that special procedures may be established by the Contractors and Local Unions and the New Jersey State Department of Labor for the training and employment of persons who have not previously qualified to be employed on construction projects of the type covered by this Agreement. The parties to this Agreement will assist in such programs and agree to use their best efforts to ensure that the goals for female and minority employment are met on this Project.

SECTION 2. LANGUAGE OF AGREEMENT

The use of the masculine or feminine gender in this Agreement shall be construed as including both genders.

ARTICLE 16 – GENERAL TERMS

SECTION 1. PROJECT RULES

The ACCC, the Project Manager and the Contractors shall establish such reasonable Project rules as are appropriate for the good order of the Project, provided they do not violate the terms of this Agreement. These rules will be explained at the pre-job conference and posted at the Project site and may be amended thereafter as necessary. Failure of an employee to observe these rules and regulations shall be grounds for discipline, including discharge. The fact that no order was posted prohibiting a certain type of misconduct shall not be a defense to an employee disciplined or discharge for such misconduct when the action taken is for cause.

SECTION 2. TOOLS OF THE TRADES

The welding/cutting torch and chain fall are tools of the particular trade having jurisdiction over the work performed. Employees using these tools shall perform any of the work of the trade. There shall be no restrictions on the emergency use of any tools or equipment by any qualified employee or on the use of any tools or equipment for the performance of work within the employee's jurisdiction.

SECTION 3. SUPERVISION

Employees shall work under the supervision of the craft foreperson or general foreperson.

SECTION 4. TRAVEL ALLOWANCES

There shall be no payments for travel expenses, travel time, subsistence allowance or other such reimbursements or special pay except as expressly set forth in this Agreement and in Schedule A limited to travel expenses.

SECTION 5. FULL WORK DAY

Employees shall be at their staging area at the starting time established by the Contractor and shall be returned to their staging area by quitting time after performing their assigned functions under the supervision of the Contractor. The signatories reaffirm their policy of a fair day's work for a fair day's wage.

SECTION 6. COOPERATION

The ACCC, Contractors and the Unions will cooperate in seeking any New Jersey

Department of Labor approvals that may be required for implementation of any terms of this Agreement.

ARTICLE 17 – SAVINGS AND SEPARABILITY

SECTION 1. THIS AGREEMENT

In the event that the application of any provision of this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law, the provision involved shall be rendered, temporarily or permanently, null and void but the remainder of the Agreement shall remain in full force and effect. In such event, the Agreement shall remain in effect for contracts already bid and/or awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties to this Agreement will enter into negotiations for a substitute provision in conformity with the law and the intent of the parties for contracts to be let in the future.

SECTION 2. THE BID SPECIFICATIONS

In the event that the Contractors' bid specifications, or other action, requiring that a successful bidder become signatory to this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law such requirement shall be rendered, temporarily or permanently, null and void but the Agreement shall remain in full force and effect to the extent allowed by law. In such event, the Agreement shall remain in effect for contracts already bid and/or awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties will enter in to negotiations as to modifications to the Agreement to reflect the court action taken and the intent of the parties for contracts to be let in the future.

SECTION 3. NON-LIABILITY

In the event of an occurrence referenced in Section 1 or Section 2 of this Article, neither the ACCC, the Architect, the Project Manager, nor any Contractor, nor any signatory Union shall be liable, directly or indirectly, for any action taken, or not taken, to comply with any court order, injunction or determination. Project bid specifications will be issued in conformance with court orders in effect and no retroactive payments or other action will be required if the original court determination is ultimately reversed.

SECTION 4. NON-WAIVER

Nothing in this Article shall be construed as waiving the prohibitions of Article 7 as to signatory Contractors and signatory Unions.

ARTICLE 18 - HELMETS TO HARDHATS

SECTION 1. UTILIZE THE CENTER FOR MILITARY RECRUITMENT

The Employers and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment ("Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

SECTION 2. CREATION OF AN INTEGRATED DATABASE OF INTERESTED VETERANS

The Unions and **Employers** agree to coordinate with the **Center** to create and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE 19 – FUTURE CHANGES IN SCHEDULE A AREA CONTRACTS

SECTION 1. CHANGES TO AREA CONTRACTS

A. The collective bargaining agreements attached as Schedule A to this Agreement shall continue in full force and effect until the Contractor and/or Union parties to the Area Collective Bargaining Agreements which are set forth in Schedule A notify the Contractors in writing of the mutually agreed upon changes in provisions of such agreements which are applicable to the Project, and their effective dates.

B. It is agreed that any provisions negotiated into any Schedule A collective bargaining agreements will not apply to work on this Project if such provisions are less favorable to this Project than those uniformly required of contractors for construction work normally covered by those agreements; nor shall any provisions be recognized or applied on this Project it may be construed to apply exclusively, or predominantly, to work covered by this Project Agreement.

C. Any disagreement between signatories to this Agreement over the incorporation into Schedule A collective bargaining agreement of provisions agreed upon in the renegotiations of Area Collective Bargaining Agreements shall be resolved in accordance with the procedure set forth in Article 9 of this Agreement.

SECTION 2. LABOR DISPUTES DURING AREA CONTRACT NEGOTIATIONS

The Unions agree that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity or other violations of Article 7 affecting the Project by any Local Union involved in the renegotiations of Area Local Collective Bargaining Agreements nor shall there by any lock-out on the Project affect a Local Union during the course of such renegotiations.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed and effective as of the _____ day of _____, 2021.

SIGNATORIES:

ATLANTIC CAPE COMMUNITY COLLEGE

_____
Authorized Signature

_____
Print Name

SOUTH JERSEY BUILDING AND CONSTRUCTION TRADES COUNCIL

_____
Authorized Signature

_____
Print Name

INDIVIDUAL UNIONS

_____
Asbestos Workers Local 89

_____
BAC Local 5

_____
Boilermakers Local 28

_____
Carpenters Local 255

_____

Cement Mason Local 592

Dockbuilders Local 441

Elevator Constructors Local 5

Glaziers Local 252

IBEW Local 351

Ironworkers Local 399

Laborers Local 172

Laborers Local 77

Laborers Local 78

Operating Engineers Local 825

Painters District Council 711

Plumbers & Fitters Local 322

_____
Roofers & Waterproofers Local 30

_____
Sheet Metal Workers Local 19
(Signs)

_____
Sheet Metal Workers Local 27

_____
Sprinkler Fitters Local 669

_____
Tapers Local 1976

_____
Teamsters Local 331

_____
Tile, Marble & Terrazzo- BAC Local 7

SCHEDULE A

LOCAL COLLECTIVE BARGAINING AGREEMENTS

(ATTACH HERE)

SCHEDULE B

LETTERS OF ASSENT

(ATTACH EXECUTED FORM HERE)

(When Executed Attached to Schedule B)

LETTER OF ASSENT

PROJECT LABOR AGREEMENT

The undersigned, as a Prime contractor or subcontractor on a Contract which is part of the construction project known as the **Construction of the Wind Safety Training Center at 1535 Bacharach Blvd. Atlantic City, NJ 08401**, for and in consideration of the award of a Contract to perform work on said Project, and in further consideration of the mutual promises made in the Project Labor Agreement, a copy of which was received and is acknowledged, hereby:

(1) On behalf of itself and all its employees, accepts and agrees to be bound by terms and conditions of the Project Labor Agreement, together with any and all amendments and supplements now existing or which are later made thereto, and understands that any act of noncompliance with all such terms and conditions, including but not limited to, evidence of compliance with the pre-employment controlled substance testing, will subject the noncomplying Contractor or employee(s) to being prohibited from the Project Site until full compliance is obtained.

(2) Certified that it has no commitments or agreements, which would preclude its full compliance with the terms and conditions of said Project Labor Agreement.

(3) Agrees to secure from any Contractor(s) (as defined in said Project Labor Agreement) which is or becomes a Subcontractor(s) (of any tier), a duly executed Letter of Assent in form identical to this document prior to commencement of any work.

_____ _____

Date Name of Contractor/Company

_____

Signature of Authorized Representative

_____

Print Name and Title

_____

Contract Number

SCHEDULE C

SCOPE OF WORK SUMMARY FOR THE CONSTRCUTION OF THE WIND SAFETY TRAINING CENTER

The College will construct a new 1,7000 square foot 24-foot-high addition to serve as the Wind Safety Training Center's permanent site.

The addition will be located on the side of the Atlantic City Campus adjacent to North New York Avenue and Artic Avenue. The building will have a prominent exterior signage identifying it as a wind industry training center, with the Atlantic Cape logo linking it to the college brand. The addition's design will allow the Wind Safety Training Center to stand out as a modern and high-profile entity, while linking it thematically/architecturally with the rest of the campus.

Along with the new space created by the addition, existing office space immediately adjacent to the planned addition will be renovated for project use. The existing "Room 167" and a utility office on the campus will become an Instructor's Room, equipped with benches and lockers for instructor use and storage of program equipment, and an office for the Project Director. In this way, existing campus space will naturally flow into the Wind Safety Training Center, and existing space will be leveraged for program use.

A fire safety training area will be constructed directly outside the addition, in an approved location by Atlantic City Code Enforcement and Atlantic City Fire Department.

END SCHEDULE C

PREVAILING WAGE COMPLIANCE DECLARATION - SECTION III

To: Atlantic Cape Community College

Re: WIND SAFETY TRAINING CENTER
ATLANTIC CITY CAMPUS
Atlantic Cape Community College
Atlantic County, Atlantic City, New Jersey

The Contractor hereby agrees to comply in all respect with the New Jersey Prevailing Wage Act, Chapter 150, P.L. 1963 as amended. A copy of the prevailing wage rates pertaining to the work and issued by the New Jersey Department of Labor and Industry entitled, "Prevailing Wage Rate Determination," is on file in the Owner's office or may be obtained from the New Jersey Department of Labor and Industry. For job categories not covered under prevailing wage rates, bidders are required to pay to workers at least the legally established minimum wage at all times during the contract period. In the event it is found that any worker employed by the Contractor or any Subcontractor covered by the contract herein has been paid a rate of wages less than the prevailing rate required to be paid by such contract, the Owner may terminate the Contractor's or Subcontractor's right to proceed with the work or such part of the work as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise. The Contractor and his sureties shall be liable to the Owner for any excess costs occasioned thereby.

Before final payment is made by or on behalf of the Owner of any sum or sums due to the work, the Contractor or Subcontractor shall file with the Owner, written statements in form satisfactory to the commissioner of Labor and Industry certifying to the amounts then due and owing from such contractor or subcontractor filing such statement to any and all workmen for wages due on account of the work, setting forth therein the names of the persons whose wages are unpaid and the amount due to each respectively which statement shall be certified by the oath of the Contractor or Subcontractor as the case may be in accordance with the said New Jersey Prevailing Wage Act.

The prevailing wage rate shall be determined by the Commissioner of Labor and Industry or his duly authorized deputy or representative.

The undersigned is an (individual (partnership) (corporation) under the Laws of the State of

_____having principal offices at _____

BIDDER _____

SIGNATURE _____

NAME _____

TITLE _____

DATE _____

END OF SECTION 004343

SITE VISIT VERIFICATION

In submitting this proposal, I verify that I and/or authorized representatives of my company have personally visited the site and acquainted myself / themselves with the conditions there existing and as noted in the specifications.

Sworn to and subscribed before me _____
(signature)

This _____ day of _____

Printed Name: _____

Company Name: _____

Address: _____

_____

Title: _____

SECTION 004343 - STATEMENT OF OWNERSHIP

This is to certify that in accordance with Chapter 33, Laws of 1977, the names and addresses of all stockholders in this corporation or partnership who own 10% or more of its stock, of any class, or of all individual partners in the partnership who own a 10% or greater interest therein, as the case may be, are listed below. If one or more such stockholder or partner is itself a corporation, or partnership, the stockholders holding 10% or more of that corporations, stock, or the individual partners owing 10% or greater interest in that partnership, as the case may be, are also listed.

NAME	ADDRESS

Authorized Person Printed Name: _____

Authorized Person Signature: _____

Representing: _____

Address: _____

_____

SECTION 004530 – STOCKHOLDER DISCLOSURE CERTIFICATION

This statement shall be completed, certified to, and included with all bid and proposal submissions. Failure to submit the required information is cause for automatic rejection of the bid or proposal.

Name of Organization: _____

Organization Address: _____

City, State, ZIP: _____

Part I Check the appropriate box

☐ I certify that the list below contains the names and home addresses of all stockholders holding 10% or more of the issued and outstanding stock of the undersigned

OR

☐ I certify that no one stockholder owns 10% or more of the issued and outstanding stock of the undersigned.

Part II Check the box that represents the type of business organization:

☐ Sole Proprietorship

☐ Corporation

☐ Partnership

☐ Subchapter S Corporation

☐ Limited Liability Company (LLC)

☐ Limited Partnership

☐ Limited Liability Partnership (LLP)

☐ Other (be specific): _____

Sign and Notarize the form below, and, if necessary, complete the stockholder list below:

Name of Individual or Business Entity	Home Address (for Individuals) or Business Address

Subscribed and sworn before me this _____ day of _____
(day) (month, year)

(Notary Public)

My Commission Expires:

_____
(Affiant)

_____
(Print name and title of Affiant)

STOCKHOLDER DISCLOSURE CERTIFICATION

SUBCONTRACTOR'S IDENTIFICATION FORM

County College Contracts Law, N.J.S.A. 18A:64A-25.25, provides that Bidders on public building projects shall provide the name or names of, and evidence of performance security from, all subcontractors to whom the bidder will subcontract the work, including plumbing and gas fitting work; heating and ventilating systems and equipment; electrical work; structural steel and ornamental iron work; all other work and materials required for the completion of the project.

Public Law P.L. 2009, c.315 - Business Registration Certificate requires that all contractors submitting bid proposals for contract work must have their business registered with the New Jersey Department of Treasury in order to contract for public work. No less than ten (10) business days prior to award of contract approved by the College's Board of Trustees, the bidder shall submit a copy of its Business Registration Certificate issued by the New Jersey Department of Treasury, Division of Revenue. The bidder has to have obtained the Business Registration Certificate prior to receipt of bids.

These Contract Documents also require the Bidder to provide the name, address, and description of work to be performed by all subcontractors.

Name of Bidder: _____

Prime Bidders shall be DPMC Classified for trades C008 (General Construction) or C009 (General Construction/Alterations and Additions).

For each prime subcontractor listed below, you are required to provide the following at the time of bid;

- Provide proof of valid DPMC Notice of Classification
- Total Amount of Uncompleted Contracts, (Form DBC-701)
- Certification of No Material Adverse Change in Status Affidavit
- Proposition of Surety*
- Consent of Surety*
- Trade License (as applicable for trade)

*Consent of Surety for subcontractors must be provided with the bid submission, unless the General Contractor's Consent of Surety covers any or all subcontractors. In this case, the Consent of Surety is not required for subcontractors who are covered by the General Contractor's Consent of Surety. General Contractor must provide proof at the time of bid.

The Business Registration Certificate shall be provided as per the timeline indicated in the Information for Bidders – Section 002113.

Provide all other required subcontractor information per 18A:64A-25.25 and as indicated on the Form of Bid Proposal.

(continued on next page)

SUBCONTRACTOR'S IDENTIFICATION FORM

The undersigned Bidder declares that the following firms will be used as subcontractors to complete certain portions of the work in this project (write "self-performed" if Prime Bidder is executing work):

Subcontractor Name and Address	Nature of Work
	Structural Steel and Ornamental Iron C029 (if not self-performed)
	Electrical C047 (if not self-performed)
	Plumbing C030 (if not self-performed)
	HVACR C039 (if not self-performed)
	Roofing-Membrane EPDM C066 (if not self-performed)
	Roofing-Metal C071 (if not self-performed)
	Site Work (C054) (if not self-performed)

ATTACH ADDITIONAL SHEETS IF NECESSARY.

Signature of Bidder's authorized representative:

Signature: _____

Title: _____

Date: _____

SURETY DISCLOSURE STATEMENT AND CERTIFICATION

_____surety(ies) on the attached bond, hereby certifies(y) the following:

1. The surety meets the applicable capital and surplus requirements of R.S. 17:17-6 or R.S. 17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

2. The capital (where applicable) and surplus, as determined in accordance with the applicable laws of this State, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ended December 31, _____(most recent calendar year for which capital and surplus amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety's capital and surplus amounts, together with the name and address of the firm of certified public accounts that shall have certified those amounts):

_____
_____
_____

3. (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each such surety that surety's underwriting limitation and the effective date thereof):

_____
_____
_____

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to R.S.17:18-9 as of (date on which such limitation was so established) is as follows (indicating for each such surety that surety's underwriting limitation and the date on which that limitation was established):

_____
_____
_____

4. The amount of the bond to which this statement and certification is attached is $_____.

5. If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3)(a) or (3)(b) above, or both, then for each such contract of reinsurance:

(continued on next page)

SURETY DISCLOSURE STATEMENT AND CERTIFICATION

(a) The name and address of each such reinsurer under that contract and the amount of that reinsurer's participation in the contract is as follows:

_____

_____

_____

(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item 5(a) satisfies the credit for reinsurance requirement established under P.L.1993, c.243 (C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

(continued on next page)

CERTIFICATE

(to be completed by an authorized certifying agent for each surety on the bond)

I_____(name of agent), as

_____(title of agent), for

_____(name of surety),

a

☐ Corporation

☐ Mutual insurance company (check one)

☐ Other

(indicating type of business organization) domiciled in _____(state of domicile),

DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOID.

Signature of certifying agent:

_____

Printed name of certifying agent:

_____

Title of certifying agent:

_____

Amended by L.1995, c.384 & 3,eff. Jan. 10, 1996; Section N.J.S.A. 18A:64A-25.17