



**PROJECT MANUAL
FOR
JONESBORO MUNICIPAL AIRPORT
MAINTENANCE HANGAR RECONSTRUCTION**

**VOLUME TWO OF TWO
TECHNICAL SPECIFICATIONS
ISSUED FOR PERMIT**

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SECTION 02361 – TERMITE CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Furnish and apply soil treatment with termiticide as indicated on the Drawings and specified herein.
- B. Provide soil treatment at all new slab-on-grade areas within the interior of building.

1.3 QUALIFICATIONS

- A. This Contractor shall be a licensed termite control operator and shall have as part of his organization a professional entomologist.

1.4 DELIVERY

- A. Chemicals shall be delivered to the Project site in a transport equipped with a gauge capable of indicating the correct number of gallons being applied to required areas.

1.5 SUBMITTALS

- A. Submittals shall comply with Section 01330 – Submittal Procedures.
- B. Submit certifications for applicator qualifications and gauge readings of applications.
- C. Submit product data including the following:
 - 1. Working solution to be used and manufacturer's printed data.
 - 2. The color of dye to be used.
 - 3. Working solution to be mixed in accordance with Bureau of Entomology, State of Arkansas Board of Health and EPA.
- D. Submit sample form of warranty per Article 1.6 of this Section.
- E. Furnish an applicator's "Certificate of Protective Treatment for Prevention of Termites" upon completion of all required FBC treatments and prior to slab-on-grade placement and provide a second copy with the project closeout documents.

1.6 WARRANTY

- A. Upon completion of the work, and as a condition of Final Acceptance, Owner shall be furnished with a written warranty stipulating that termiticide treatment shall prevent subterranean termites from attacking and damaging the building or its contents for a period of not less than 5 years, starting from date of Substantial Completion of the building.
- B. If subterranean termite activity exists in or under the building during the warranty period, the Contractor promptly, and without expense to the Owner, shall:
 - 1. Retreat the soil to prevent subterranean termites from attacking the building or its contents, using means acceptable to the Owner.
 - 2. Make good all damage caused by subterranean termite activity, up to Ten Thousand Dollars (\$10,000.00).
 - 3. The warranty shall be written in favor of the Owner. A specimen of the form of warranty shall be submitted to the Architect for review prior to commencement of work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Working solutions shall be based on any of the following termiticides in the strength indicated and meeting approval of all Federal, State and Local Regulatory agencies:
 - 1. “Altriset”; Syngenta.
- B. Dye, of any type, such as Blazon by Milliken Chemicals, not chemically harmful to termiticide emulsions and red or blue in color shall be added to solution before application.
- C. Solution shall be mixed in strict accordance with spray solution chart as prepared by the Bureau of Entomology, State of Arkansas Board of Health and EPA.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Termiticides shall be applied by experienced skilled mechanics and in the best workmanlike manner of this trade.
- B. Termite control shall not begin until all the subgrade soil preparation work has been completed and made ready for the vapor barrier installation.
- C. Termiticides shall not be applied when soil is excessively wet as determined by the Owner’s Testing Laboratory.

3.2 APPLICATION

- A. Application for emulsion shall be applied as follows, but in NO CASE less than the manufacturer's printed directions for use for preconstruction treatment.
- B. Horizontal Barriers: Termiticides shall be applied uniformly to all areas that will be covered by concrete slabs, including beneath sidewalks and entrance platforms adjacent to the building.
 - 1. To produce a horizontal barrier, apply the emulsion at the rate of 1 gallon per 10 square feet of backfill.
 - 2. If the backfill is washed gravel or other coarse material, apply at 1-1/2 gallons per 10 square feet.
 - 3. At critical areas such as along the inside of foundation walls, around plumbing, utility services, and other features that will penetrate the concrete slab(s), apply emulsion at 2 gallons of solution per 5 linear feet to soil.
 - 4. Applications shall be made with pressures less than 50 psi at the nozzle, using a coarse spray nozzle.
 - 5. If concrete slabs cannot be poured over soil the same day it has been treated, a waterproof cover shall be placed over the soil to prevent erosion.
- C. Vertical Barriers: Vertical barriers shall be established in soil which will be under the perimeters of floating or supported slabs, around utilities and in other critical areas which will be covered by concrete. After the final exterior grading is completed, vertical barriers shall be created in backfilled soil against foundation walls or against the outside of monolithic slab.
 - 1. To produce a vertical barrier, apply the emulsion at the rate of 4 gallons per 10 linear feet of depth from grade to the top of the footing.
 - 2. In hollow concrete masonry unit voids, apply emulsion at the rate of 2 gallons per 10 linear feet.
- D. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities.

END OF SECTION 02361

SECTION 03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 - Submittals.
- B. Section 01 41 10 - Structural Special Inspections and Testing.
- C. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Standard Specifications for Structural Concrete.
- C. ACI 315 - Details and Detailing of Concrete Reinforcement.
- D. ACI 318 - Building Code Requirements for Structural Concrete.
- E. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- F. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- G. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
- H. AWS D12.1 - Recommended Practices for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction.
- I. AWS D1.4 - Structural Weld Code - Reinforcing Steel.
- J. CRSI - Manual of Practice, and Documents 63 and 65.

1.3 SUBMITTALS

- A. Submit shop drawings as follows:
 - 1. Notify Structural Engineer prior to detailing reinforcing steel shop drawings.
 - 2. Indicate size, spacings, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules, splice lengths, stirrup spacing, supporting and spacing devices. Detail reinforcing steel in accordance with ACI 315 and CRSI Standards.
 - 3. Plans, details, and manufacturer data for splicers, dowel adhesive,

- headed shear stud reinforcement, and plate dowels as applicable to the project.
 - 4. Written description of reinforcement without adequate sections, elevations, and details is not acceptable.
 - 5. Reproduction of Structural Drawings for shop drawings is not permitted.
- B. Submit, for information only, a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.
- C. Submit, for information only, mill test reports.
- D. Submit manufacturer's data for tensile and compressive splicers.

1.4 QUALITY ASSURANCE

- A. Coordinate and schedule in a timely manner with the Structural Testing/Inspection Agency the following quality related items:
- 1. Verify reinforcing steel for quantity, size, location, and support.
 - 2. Verify proper reinforcing steel concrete coverage.

1.5 STORAGE AND PROTECTING

- A. Store reinforcing steel above ground so that it remains clean. Maintain steel surfaces free from materials and coatings which might impair bond.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Deformed reinforcing steel shall conform to ASTM A615, refer to Structural Drawings for grade (Grade 60 minimum).
- B. Welded steel wire fabric shall conform to ASTM A185.

2.2 ACCESSORY MATERIALS

- A. Annealed steel tie wire shall be 16-1/2 gage minimum.
- B. Bar supports shall be plastic-tipped steel Class I bar supports conforming to CRSI Specifications. Concrete brick may be used to support reinforcement to obtain proper clearance from earth.

2.3 SPLICERS

- A. Tensile splicers shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.
- B. Compression splicers shall be the mechanical type such that the compression stress is transmitted by end bearing held in concentric contact.

2.4 DOWEL ADHESIVE

- A. Adhesive for dowels in existing concrete shall be either EPCON System Ceramic 6 Epoxy adhesive supplied by ITW Ramset/Red Head, HIT HY200 injection adhesive supplied by Hilti Fastening Systems, Power-Fast epoxy injection gel supplied by Powers Fastening Company, Acrylic-Tie adhesive supplied by Simpson Strong-Tie Co., or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Fabricate steel in accordance with ACI 318 and CRSI standards.
- B. Bend bars cold. Do not heat or flame cut bars. No field bending of bars partially embedded in concrete is permitted, unless specifically approved by Structural Engineer and checked by Testing and Inspection Agency for cracks.
- C. Weld only as indicated. Perform welding in accordance with AWS D12.1 and or AWS D1.4.
- D. Tag reinforcing steel for easy identification.

3.2 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles and coatings.
- B. Place, support, and secure reinforcement against displacement in accordance with ACI 318 and CRSI standards. Do not deviate from alignment or measurement.
- C. Place concrete beam reinforcement support parallel to main reinforcement.
- D. Locate welded wire fabric in the top third of slabs. Overlap mesh one lap plus two inches at side and end joints.
- E. Furnish and install dowels or mechanical splices at intersections of walls, columns and piers to permit continuous reinforcement or development lengths at such intersections.
- F. Maintain cover and tolerances in accordance with ACI and CRSI Specifications, unless indicated otherwise on Structural Drawings.

3.3 SPLICES

- A. Do not splice reinforcement except as indicated on Structural Drawings.
- B. Tension couplers may be used and installed in accordance with manufacturer's

specifications.

3.4 DOWELS IN EXISTING CONCRETE

- A. Install dowels and dowel adhesive in accordance with manufacturer's recommendations.
- B. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

END OF
SECTION

SECTION 03 30 00 - CAST-IN-PLACE

CONCRETE PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

- 1. Encasement of Existing Columns

- B. WORK INCLUDED

- 1. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including bracing, proprietary forming systems, prefabricated forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.
- 2. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, ties and supports.
- 3. Furnish all labor and materials required to perform the following:
 - a. Cast-in-place concrete
 - b. Concrete mix designs
 - c. Grouting structural steel

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, Slag Cement, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture submit proposed mix designs in accordance with ACI 318, chapter 5. Each proposed mix design shall be accompanied by a record of past performance.
 - 1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

2. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, tie spacing, hoop spacing, and supports for concrete reinforcement.
 1. Do not reproduce the structural drawings for use as shop drawings.
 2. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.
 - D. Steel Reinforcement Submittals for Information: Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.
 - E. Welding certificates.
 - F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 1. Aggregates.
 - G. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials
 2. Admixtures
 3. Form materials and form-release agents
 4. Steel reinforcement and accessories
 5. Bonding agents
 6. Adhesives
 7. Repair materials
 - H. Submit manufacturer's certification of maximum chloride ion content in admixtures.
 - I. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.
 - J. Field quality-control test and inspection reports.
 - K. Minutes of preinstallation conference.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C

1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete,"
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form removal limitations, steel reinforcement installation, concrete repair procedures, and concrete protection.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - B. Store all proprietary materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 EMBEDDED METAL ASSEMBLIES

- A. Steel Shapes and Plates: ASTM A36
- B. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- D. Reinforcing Bars to be Welded: ASTM A706.
- E. Coatings
 - 1. Epoxy coating for metal assemblies shall be "Hi-Build Epoxoline," as manufactured by the Tnemec Company, Kansas City, Missouri, applied in accordance with manufacturer's recommendations.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Slag Cement: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: As indicated on drawings.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 1602/C 1602M and potable.

2.6 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M,

Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. BASF Construction Chemicals – Building Systems; Kure 200.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec by Dayton Superior; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
- f. Edoco by Dayton Superior; Res X Cure WB.
- g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
- h. Kaufman Products, Inc.; Thinfilm 420.
- i. Lambert Corporation; Aqua Kure-Clear.
- j. L&M Construction Chemicals, Inc.; L&M Cure R.
- k. Meadows, W. R., Inc.; 1100 Clear.
- l. Nox-Crete Products Group; Resin Cure E.
- m. Right Pointe; Clear Water Resin.
- n. SpecChem, LLC; Spec Rez Clear.
- o. Symons by Dayton Superior; Resi-Chem Clear.
- p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
- q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.8 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.
- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

2.9 REPAIR MATERIALS

- A. Repair Mortar – Hand-Applied: Pre-packaged, cement-based, two-component, polymer- modified, trowel-grade mortar, enhanced with penetrating corrosion inhibitor.
1. Compressive Strength: 1200 psi minimum at 1 day; 6000 psi minimum at 28 days when tested according to ASTM C 109.
 2. Bond Strength: 1800 psi minimum at 28 days when tested according to ASTM C 882 (Modified).
 3. Product / Manufacturer: SikaTop 122 Plus or SikaTop 123 Plus, Sika Corporation, or approved equal.
- B. Repair Mortar – Form and Pour or Pump: Pre-packaged, cement-based, single-component, polymer-modified, silica-fume-enhanced, cementitious mortar.
1. Compressive Strength: 3000 psi minimum at 1 day; 6500 psi at 28 days when tested according to ASTM C 109.
 2. Bond Strength: 2200 psi at 28 days when tested according to ASTM C 882 (modified).
 3. Product / Manufacturer: Sika MonoTop 611, Sika Corporation, or approved equal.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
 2. Required average strength above specified strength:
 - a. Based on a record of past performance: Determination of required average strength above specified strength shall be based on the standard deviation record of the results of at least 30 consecutive strength tests in accordance with ACI 318, Chapter 5.3 by the larger amount defined by formulas 5-1 and 5-2.
 - b. Based on laboratory trial mixtures: Proportions shall be selected on the basis of laboratory trial batches prepared in accordance with ACI 318, Chapter 5.3.3.2 to produce an average strength greater than the specified strength $f'c$ by the amount defined in table 5.3.2.2.
 - 1) Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier.
 - 2) For each proposed mixture, at least three compressive test cylinders shall be made and tested for strength at the specified age. Additional cylinders may be made for testing for information at earlier ages.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 20 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Slag Cement: 50 percent.
 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Do not use admixtures which have not been incorporated and tested in accepted mixes.
 2. Use water-reducing admixture in concrete, as required, for placement and workability.
 3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 4. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated on drawings.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 FABRICATION OF EMBEDDED METAL ASSEMBLIES

- A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.
- C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.
- D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with an epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after

welding with same type of paint.

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.
 - 1. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 - 1. Vertical alignment:
 - a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
 - b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.
 - 2. Lateral alignment:
 - a. Members - 1 inch.
 - b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.
 - 3. Level alignment:
 - a. Elevation of top of concrete encasement - 1/2 inch.
 - 4. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.
 - a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
 - b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
 - c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for column surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.
1. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - a. Spacing within a bolt group: 1/8"

- b. Location of bolt group (center): 1/2"
- c. Rotation of bolt group: 5 degrees
- d. Angle off vertical: 5 degrees
- e. Bolt projection: $\pm 3/8$ "

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
 - 2. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
 - 3. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not weld reinforcing bars.
- D. Installation tolerances:
 - 1. Top and bottom bars in slabs, girders, beams and joists:
 - a. Members 8" deep or less: $\pm 3/8$ "
 - b. Members more than 8" deep: $\pm 1/2$ "

2. Concrete Cover to Formed or Finished Surfaces: $\pm 3/8$ " for members 8" deep or less; $\pm 1/2$ " for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.
- E. Concrete Cover: Refer to the Structural Notes.
- F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.
- G. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.
- H. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, and only if specifically noted as withheld on the batch ticket.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 2. Water content shall not exceed the maximum specified water/cement ratio for the mix.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
 4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its

- outlet near the bottom of the place of deposit.
5. Pump priming grout shall be discarded and not used in the structure.
- D. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- E. Hot-Weather Placement: Comply with ACI 305.1 and as follows:
1. Maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to all concrete surfaces.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in- place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 INSTALLATION OF NON-SHRINK GROUT

- A. Grout all spaces indicated to be filled with grout. Comply with manufacturer's instructions. Do not dry pack.
- B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be used in 20 minutes. Under no circumstances shall grout be retempered.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot- weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 CONCRETE SURFACE REPAIRS

- A. Surface Defects in Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Owner's approval.
- B. Contractor shall submit a detailed, descriptive procedure listing proposed pre-packaged repair materials and methods for the repair of surface defects prior to the start of repair work.
- C. Patching Mortar: Mix, place and finish pre-packaged repair mortar in accordance with manufacturer's instructions.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, minor honeycombs and rock pockets with no exposed reinforcement, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out minor honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface, 1/4 inch deep minimum. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view using pre-packaged repair mortar so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3.11 STRUCTURAL REPAIRS

- A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.
- B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.
 1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.
- C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.12 CLEANUP

- A. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.
- B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner may engage a special inspector and/or a qualified

testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure four cylinders for each composite sample.
 - 1) Do not transport field-cast cylinders until they have cured for a minimum of 24 hours.
7. Compressive-Strength Tests: ASTM C 39/C 39M;
 - a. Test one cylinder at 7 days
 - b. Test two cylinders at 28 days
 - c. Test one cylinder at 56 days if needed.
 - d. If 4" by 8" cylinders are used, provide 1 additional cylinder at each stage

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 - a. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedure set forth in ACI 301, Section 1.6. Locations of core tests shall be approved by the Architect. Core sampling and testing shall be at Contractor's expense.
 - b. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 04810 - UNIT MASONRY ASSEMBLIES

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. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry-joint reinforcement.
 - 5. Ties and anchors.
 - 6. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
- C. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
 - 2. Section 07190 "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 3. Section 07620 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Precast Concrete Sill Units: Show sizes, profiles, and locations of each precast unit required.
3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.6 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include data on material properties.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include name of manufacturer, brand name, and type.
 3. Mortar admixtures.
 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 5. Grout mixes. Include description of type and proportions of ingredients.
 6. Reinforcing bars.
 7. Joint reinforcement.
 8. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Mockups: Build mockups to verify to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area.
 - 2. Build mockups for typical exterior and interior walls in sizes approximately 72 inches long by 48 inches high by full thickness.
 - a. Include lower corner of window opening, framed with precast sill units, at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.5 MASONRY LINTELS

- A. General: Provide one of the following:
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 PRECAST SILL UNITS

- A. Precast Concrete: Compressive strength 4,000 - 6,000 PSI at 28 days, with portland white cement conforming to ASTM C-150.
- B.

1. Reinforcing M13 #4, Grade 60 rebar.
2. Aggregate-Fine carefully graded and washed natural sand conforming to ASTM C-33.
3. Shape as indicated on the drawings.

2.7 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 2. Pigments shall not exceed 10 percent of portland cement by weight.
- D. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- G. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation.
 - b. Euclid Chemical Company (The); an RPM company.

- I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- J. Water: Potable.

2.8 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter.
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 6. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.9 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
 3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.
- D. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- F.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. For exterior masonry, use portland cement-lime mortar.
 4. For reinforced masonry, use portland cement-lime mortar.
 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type M or Type S.
 - 3. For mortar parge coats, use Type S or Type N.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
 - a.

- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.

- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

- B. Build chases and recesses to accommodate items specified in this and other Sections.

- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
 - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Install clay flue liners to comply with ASTM C 1283. Install flue liners ahead of surrounding masonry. Set clay flue liners in full bed of refractory mortar 1/16 to 1/8 inch thick. Strike joints flush on inside of flue to provide smooth surface. Maintain expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners.
- D. Set precast sill units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.
- E. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- G. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- H. Cut joints flush where indicated to receive waterproofing or air barriers unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL JOINTS

- A. General: Install control-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
- D.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.
 - 2.

3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
 - 1.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.12 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
 - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 8. Clean stone trim to comply with stone supplier's written instructions.
 - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04810

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 - Submittals.
- B. Section 01 41 10 - Structural Special Inspections and Testing.

1.2 REFERENCES

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- D. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
- C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
 - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- B. Engineering Responsibility: Preparation of Shop Drawings, and other structural data by a qualified person.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. Comply with all AISI Specifications and Standards.

1.5 STORAGE AND PROTECTING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H (ST230H)
 - 2. Grade: ST50H (ST340H)
 - 3. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90)
- B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges (refer to drawings for sizes).
- C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges (refer to drawings for sizes).

2.2 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003 A/A 1003M, Structural Grade, Type H or Type L, metallic coated, of same grade and coating weight used for framing members.

2.3 ANCHORS, CLIPS, AND FASTENERS

- A. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- B. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws. 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- C. Welding Electrodes: Comply with AWS standards.

2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.5 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written

instructions, and requirements in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cold-formed metal framing according to AISI's "North American Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install shop fabricated, cold-formed framing and securely anchor to supporting structure.
- C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track.
- E. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960).

3.2 EXTERIOR NON-LOAD BEARING WALL INSTALLATION

- A. Fasten both flanges of studs to top and bottom track.
- B. Install horizontal bridging in wall studs, spaced in rows no more than 48 inches apart. Fasten bridging at each stud.
- C. Install miscellaneous framing and connections to provide a complete and stable wall-framing system.

3.3 FIELD QUALITY CONTROL

- A. Refer to Structural Drawings and General Structural Notes for Inspection Requirements.
- B.
- C. Remove and replace work where test results indicate that it does not comply with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF
SECTION

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Stainless Steel Corner Guards.
- 2. Metal bollards.
- 3. Miscellaneous angles, tubes, and steel shapes as required for the work to be furnished and installed (i.e. glue-laminated timber, counters, benches, etc.)

- B. Related Sections:

- 1. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts and other items cast into concrete.
- 2. Division 5 Section "Structural Steel".

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.

- 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- 2. Plan showing corner guard locations and heights.

- B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, registered in the State of Florida, responsible for their preparation.

- C. Prime Paint and Galvanizing Coating Product Data.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer, registered in the State of Florida.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes. All fabrications shall be prime painted with zinc rich primer. Fabrications that are not fully concealed shall be painted in accordance with Division 9 "Interior Painting."

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for interior use at stainless steel applications. Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3.
- G. Lag Screws: ASME B18.2.1.
- H. Plain Washers: Round, ASME B18.22.1.
- I. Lock Washers: Helical, spring type, ASME B18.21.1.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 4000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections and Drawings as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Prime miscellaneous interior framing and supports with zinc-rich primer unless otherwise specified in Division 9 Section "Interior Painting." Galvanize fabrications for

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 - Submittals.
- B. Section 01 41 10 - Structural Special Inspections and Testing.

1.2 REFERENCES

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- D. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- B. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
- C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
 - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- B. Engineering Responsibility: Preparation of Shop Drawings, and other structural data by a qualified person.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. Comply with all AISI Specifications and Standards.

1.5 STORAGE AND PROTECTING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H (ST230H)
 - 2. Grade: ST50H (ST340H)
 - 3. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90)
- B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges (refer to drawings for sizes).
- C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges (refer to drawings for sizes).

2.2 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003 A/A 1003M, Structural Grade, Type H or Type L, metallic coated, of same grade and coating weight used for framing members.

2.3 ANCHORS, CLIPS, AND FASTENERS

- A. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- B. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws. 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- C. Welding Electrodes: Comply with AWS standards.

2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.5 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written

instructions, and requirements in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cold-formed metal framing according to AISI's "North American Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install shop fabricated, cold-formed framing and securely anchor to supporting structure.
- C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track.
- E. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960).

3.2 EXTERIOR NON-LOAD BEARING WALL INSTALLATION

- A. Fasten both flanges of studs to top and bottom track.
- B. Install horizontal bridging in wall studs, spaced in rows no more than 48 inches apart. Fasten bridging at each stud.
- C. Install miscellaneous framing and connections to provide a complete and stable wall-framing system.

3.3 FIELD QUALITY CONTROL

- A. Refer to Structural Drawings and General Structural Notes for Inspection Requirements.
- B.
- C. Remove and replace work where test results indicate that it does not comply with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF
SECTION

exterior use with G90 coating.

2.8 METAL BOLLARDS

- A. Fabricate metal bollards from 1/4-inch wall-thickness round steel tubing.
 - 1. Bollards to be concrete filled will be fabricated with holes for concrete fill application and galvanizing and provided with a vinyl sleeve cover to match existing.
- B. Hot-dip galvanize after fabrication.
- C. Plastic Cover: Polyethylene Thermoplastic (HDPE) tubes having ultra-violet resistance and antistatic properties, normal thickness 0.250 inches. Color shall be OHS A yellow unless otherwise noted. Size covers for pipe diameters.

2.9 STAINLESS STEEL CORNER GUARDS

- A. Stainless steel corner guards Type 304, 16 gauge, 2" x 2", with vertical grain-brushed finished – No. 4 – full wall height unless noted otherwise.
- B. Factory applied two sided tape or field applied construction adhesive.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products at all exterior locations.
 - 1. G90 coating.
 - 2. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 3. Touch-up galvanized coating after field welding is completed.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment,

and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, epoxy set anchors, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete where noted on the Drawings and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 INSTALLING CORNER GUARDS

- A. Examination:

1. Examine areas and conditions in which the corner guard systems will be installed.
2. Complete all finishing operations, including painting, before beginning installation of corner guards.
3. Wall surface shall be dry and free from dirt, grease and loose particles.

B. Preparation:

1. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

C. Installation:

1. General: Locate the Corner Guard as indicated on the Architect accepted shop drawing for the appropriate substrate and install corner guard level and plumb as the indicated on the shop drawings.
2. Installation of Stainless Steel Corner Guards
 - a. Surface must be dry, clean and property sealed.
 - b. Two-sided tape: Peel paper from the factory applied tape and apply pressure until a light fit is achieved, or; Cement on: Apply a premium heavy-duty construction adhesive in a zigzag pattern over the back of each wing of the corner guard. Position corner guard on the wall and apply pressure until a tight fit is achieved.
 - c. Remove the protection plastic covering from the exposed surface of the corner guard.

D. Cleaning

1. At completion of the installation, clean surfaces with a natural based, non-abrasive cleaner. Ammonia and alcohol based cleaners may be used.

END OF SECTION 05500

SECTION 06105 – MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Rough carpentry work not specified elsewhere and generally intended for support of other work.
 - 2. Wood furring/blocking
 - 3. Wood equipment bases.
 - 4. Miscellaneous blocking, grounds, nailers, and panels.
 - 5. Plywood panels.
- B. Particle Board and MDF is not acceptable as a substitute for plywood.
- C. Related Sections include the following:
 - 1. Division 6 Section “Interior Finish Carpentry”.
 - 2. Division 7 Section “Sheet Metal Flashing and Trim” and Roof Accessories”

1.3 ACTION SUBMITTALS

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

5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 1. Preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Power-driven fasteners.
 4. Powder-actuated fasteners.
 5. Expansion anchors.
 6. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
- B. Quality Standard: Comply with AWI AWS for grades of architectural woodwork, construction, finishes, and other requirements. Provide AWI certification labels or AWI certificates of compliance indicating that woodwork meets requirements of grades specified.

Surface Burning Characteristics Provide materials with the following characteristics as determined by testing identical products per ASTM test method indicated below by Underwriters Laboratories, Inc. (UL), Intertek Testing Services (ITS), Hardwood Plywood and Veneer Association (HPVA), or another inspecting and testing agency acceptable to authorities having jurisdiction.

1. Surface burning characteristics shall not exceed values indicated or required by Local Codes and tested per ASTM E 84.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack material above ground level on uniformly spaced supports to prevent deformation.
- B. For material pressure treated with waterborne chemicals, place spacers between each bundle for air circulation.
- C. Remove or loosen plastic wrappings. Sticker individual panels to hasten acclimatization.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Grade Stamps: Furnish lumber with each piece factory-marked with grade stamp of inspection agency that indicates grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. Sizes: Provide nominal sizes indicated, complying with PS 20 except where actual sizes are specifically noted as being required.
- C. Surfacing: Dressed lumber, S4S, unless otherwise indicated.
- D. MDF or particle board is not acceptable.

2.2 DIMENSION LUMBER FOR CONCEALED CONDITIONS

- A. Species: Any wood species listed by PS 20.
- B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
- C. Grade: No. 2 or standard grade.

2.3 DIMENSION LUMBER FOR EXPOSED CONDITIONS

- A. Species: Any wood species listed by PS 20.
- B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
- C. Grade: No. 2 or standard grade.

2.4 BOARDS FOR CONCEALED CONDITIONS

- A. Species: Any wood species listed by PS 20.
- B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
- C. Grade: No. 2, 2 Common, or Construction Boards.

2.5 BOARDS FOR EXPOSED CONDITIONS

- A. Species: Any wood species listed by PS 20.
- B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).
- C. Grade: No. 2, 2 Common, Construction Common, or Construction Boards.

2.6 BOARDS FOR WET CONDITIONS

- A. Boards for wet conditions, such as base cabinets with sinks or subject to wetting shall be constructed of Marine Grade Plywood.
- B. Species: Douglas fir or Western Larch
- C. Moisture Content: S-Dry, KD 19 or MC 19 (19 percent maximum moisture content).
- D. Grade: All plies of veneer shall be B or better – (B-B Marine Grade).
- E. The exposure durability rating is “Exterior” and the glue used shall be fully waterproof structural adhesive.

2.7 CONSTRUCTION PANELS

- A. Standards: Comply with requirements of PS 1 Voluntary Product Standard "Construction and Industrial Plywood" for veneer plywood and APA PRP-108 "Performance Standards and Policies for Structural-Use Panels" for performance-rated panels.
 - 1. Trademark: Furnish construction panels that are each factory-marked with APA trademark for grade specified.
- B. Miscellaneous Exposed Plywood: DOC PS 1, A-D Interior, thickness as indicated but not less than ½-inch.
- C. Miscellaneous Concealed Plywood: C-C Plugged Exterior, thickness as indicated but not less than ½-inch nominal.
- D. Electrical/Telephone Backing Panels: C-D Plugged, Exposure 1 plywood panels, fire-retardant treated, thickness as indicated but not less than ¾" inch nominal. (4'-0" X 8'-0")

2.8 FASTENERS

- A. General: Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads and Staples: FS FF-N-105.
- C. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.
- D. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and

ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.9 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General: Obtain preservative-treated lumber complying with AWWA Standard C2. Mark each treated item with AWPB or SPIB Quality Mark Requirements. Coat surfaces cut after treatment to comply with AWWA M4.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Above-Ground Wood Treatment: Pressure treat with waterborne preservatives to a minimum retention of 0.25 pcf.
 - 1. Kiln-dry interior dimension lumber after treatment to 19 percent maximum moisture content.
 - 2. Treat wood items indicated and in the following circumstances:
 - a. In contact with roofing, flashing, or waterproofing.
 - b. In contact with masonry or concrete.
 - c. Within 18 inches of grade.
- C. Ground-Contact Wood Treatment: Pressure treat with waterborne preservatives to a minimum retention of 0.40 pcf.

2.10 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

- A. General: Identify treated wood with appropriate classification marking of Underwriters Laboratories Inc. or other testing and inspection agency acceptable to authorities having jurisdiction.
- B. Dimension Lumber: Comply with AWWA C20.
 - 1. Treatment Types: Interior Type A for protected wood and Exterior Type for wood exposed to weather.
- C. Plywood: Comply with AWWA C27.
 - 1. Treatment Types: Interior Type A for protected wood and Exterior Type for wood exposed to weather.
- D. Inspect each piece after drying and discard damaged or defective pieces.

PART 3 - PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Condition work to average prevailing humidity conditions in installation areas before installing. Before installing work, examine shop-fabricated work for the completion and complete work as required.

3.3 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of miscellaneous carpentry and in sizes that would require an excessive number or poor arrangement of joints.
- B. Cut and fit miscellaneous carpentry accurately. Install members plumb and true to line and level.
- C. Coat cut edges of preservative-treated wood to comply with AWPA M4.
- D. Securely fasten miscellaneous carpentry as indicated and according to applicable Florida building codes and recognized standards.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.
- G. Quality Standard: Install architectural woodwork to comply with AWI AWS for the same grades specified in Part 2 – Products of this Section for type of architectural woodwork involved.
- H. Fire Retardant - Treated Wood: Handle, store, and install fire retardant – treated wood to comply with recommendations of chemical treatment, manufacturer, including, but not limited to, those for adhesives used to install architectural woodwork.
- I. Installation Tolerances: Install architectural woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims.

3.4 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install where shown and where required for screeding or attachment of other work. Cut and shape to required size. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.5 WOOD FURRING

- A. General: Install at spacing indicated, with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

3.6 CONSTRUCTION PANELS

- A. Comply with applicable installation recommendations in APA Form E30 "Design/Construction Guide--Residential & Commercial."
- B. Install Electrical/Telephone Backing Panels as required to accommodate equipment.
 - 1. Obtain Fire Marshall approval and acceptance of fire-rated panels prior to painting surfaces.

3.7 ADJUSTING AND CLEANING

- A. Repair damaged and defective work where possible to eliminate functional and visual defects. Where not possible to repair, replace the work.
- B. Clean architectural woodwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the installer, that shall ensure that the work shall be without damage at time of Substantial Completion.

END OF SECTION 06105

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Plastic-laminate cabinets.
 - 2. Solid-surfacing-material countertops and splashes and millwork.
 - 3. Cabinet accessories.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications".
 - 2. Division 6 Section "Miscellaneous Carpentry" for wood blocking required for installing woodwork and concealed within other construction before woodwork installation.
 - 3. Division 6 Section "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
 - 4. Division 6 Section "Fire Retardant Treatment (Fire Retardant Treated Wood)" for fire retardant treatment for wood products.
 - 5. Division 7 Section "Joint Sealants" for sealant schedule.
 - 6. Division 9 Section "Interior Painting" for field applied finishes and stains.
 - 7. Division 10 Section "Toilet Compartments" for toilet partitions and screens.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
4. Show locations of vents for computer equipment and grommets for cable wiring for power, data, and telephone equipment connections.

C. Samples for Initial Selection:

1. Shop-applied opaque finishes.
2. Plastic laminates.
3. PVC edge material.
4. Solid surface samples.
5. Cabinet Hardware samples when requested by the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product, signed by product manufacturer.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 1. Provide AWI Quality Certification Program certificates indicating that woodwork, including installation, complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.
- E. Pre-installation Conference: Conduct conference at Project site to comply with

requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Coordinate sizes of computer equipment, or other equipment provided by the Owner, that is integral to the cabinetry work.

PART 2 - PRODUCTS

2.1 MATERIALS

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

- B. Certified Wood: Interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 3. Marine Plywood: BS 1088, Medium Density Overlay.
 - 4. NO PARTICLEBOARD MDF, OR FIBERBOARD SHALL BE USED.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Abet Laminati, Inc.
 - b. Arborite; Division of ITW Canada, Inc.
 - c. Lamin-Art, Inc.
 - d. Wilsonart.
 - e. Nevamar Company, LLC; Decorative Products Div.
 - 2. Color: As scheduled on the Drawings or specified to match existing millwork to be selected from manufacturer's full range of colors. Refer to article "Solid-surfacing Material Countertops and Integral Sinks" this section for additional information.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2. "Corian" or Architect and Owner approved substitution the color and properties of any proposed substitution shall be an exact match to the materials specified or scheduled, subject to the approval of the Owner.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)." Basis of Design: Hafele or Architect approved equal.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.
- C. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter. Steel, matte nickel finish.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; recessed; with shelf rests, B04081. Flush with cabinet interior face. Groove plug for wood shelves 3/4" thick at book cases and 1/2" thick at interior cabinets.

- E. Rakks Angle Counter Support Bracket EH-1818-P: Primed finish. Painted to match wall color.
- F. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
- G. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Product: Subject to compliance with requirements, provide "SG series" by Doug Mockett & Company, Inc. or polished edge of the through color solid surface material where approved by the Architect.
- H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base or as selected by Architect from manufacturer's standard available finishes.
- I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- J. Kitchen/ Break Area: Under Counter Pull out Trash Cans: Concealed pull-out trash bin, heavy duty side wall mounted guides, (1) one 36 quart gray bin. Hafele – 503.88.990 , or Architect approved equal.
- K. Restroom Trash Bin: The pull out trash bin shall be supported and enclosed within a custom heavy gauge 316 stainless steel clad-plywood enclosure, under the counter and overhead supported by the counter top, with clear floor space below the cabinet enclosure and lockable continuous hinged stainless steel door lock shall be keyed to building standard. Refer to the drawings for profile, dimension & size of stainless steel trash bin.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content. All concealed blocking shall be fire retardant.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Adhesives shall not contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the

following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

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

2.4 FABRICATION, GENERAL

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

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

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

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails:
1/16 inch.

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

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

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

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

2.5 PLASTIC-LAMINATE CABINETS

- A. Grade: Custom.
- B. AWI Type of Cabinet Construction: Reveal overlay Reveal overlay on face frame.
- C. Reveal Dimension: 1/2 inch.
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: PVC edge banding, 012 inch thick, matching laminate in color, pattern, and finish.
- E. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 012 inch thick, matching laminate in color, pattern, and finish.
 - b. For semi exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
 - 2. Drawer Sides and Backs: Plywood backed decorative panels or wood clear finish as selected by Architect.
 - 3. Drawer Bottoms: Plywood backed decorative panels or wood clear finish as selected by Architect.
- F. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Match existing millwork as approved by Architect and Owner from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.
- H. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- I. Use marine grade plywood with plastic laminate veneer for all counter tops, cabinet bases and cabinet boxes with sinks.

2.6 SOLID-SURFACING WINDOW SILLS AND RESTROOM COUNTER TOPS

- A. Grade: Premium.
- B. Solid-Surfacing-Material Thickness: 1/2 inch or 3/4 inch or composite thickness to achieve profiles shown on drawings. Thickness shall be built up to 1 1/2" @ counter edges, top openings, and sink rims.
- C. Bullnose edge: Manufacturer's standard composite bull nose edge at counter tops and window sills, 1 1/2" total thickness at counter top edge and window sills; edge openings at sinks to be flush with sink and edge openings at trash chute to be 1/8" radius eased edge.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. Basis-of-Design shall be "Dupont" Corian, colors for restrooms and other areas shall be category C or E "Terra Collection." Multiple color selections per Architect's and Owner's selection.
 - 2. Integral Sinks – Corian "Designer White" – category "C"
- E. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, silicone, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated or specified.
 - 2. Fabricate tops with loose backsplashes for field application, at back and sides of counter tops unless noted otherwise and integral sills are scheduled or required.
 - 3. All supporting substrates will be fully concealed, cut outs in counter tops shall be trimmed in solid surface material where cutouts are indicated on the drawings.
 - 4. Coordinate and pre drill holes for plumbing fixtures and scheduled accessories.
 - 5. Field verify dimensions of the countertops & template before fabrication.
- F. Install integral sink bowls in countertops in shop.
- G. Drill holes in countertops for plumbing fittings and soap dispensers in shop. Polish all edges.
- H. Refer to Section "Joint Sealants" – Sealants for mildew resistant silicone sealant to be used at counter tops.

2.7 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

- C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.
- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Back priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back priming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 3. Secure backsplashes to walls with adhesive.
 4. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 06402

SECTION 06703 – FIRE RETARDANT TREATMENT (FIRE RETARDANT TREATED WOOD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fire retardant treatment for wood, including framing, decking, sheathing and other wood construction, not exposed to weather.
- B. Related Sections include the following:
 - 1. Division 6 Section “Miscellaneous Carpentry” for wood blocking and plywood construction panels.

1.3 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. Most recent editions should be used.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM D 5516 Standard Test Method for Evaluating the Flexural Properties of Fire Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
 - 2. ASTM D 5664 Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
 - 3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. American Wood Protection Association (AWPA):
 - 1. AWPA Standard P25 Standard for Waterborne Preservatives.
 - 2. AWPA Standard P49 Fire Retardant Formulations.
 - 3. AWPA Standard U1, Use Category System.
- D. Military Specification (Mil. Spec.):
 - 1. Mil. Spec. L-19140E Lumber and Plywood, Fire-Retardant Treated.

- E. National Fire Protection Association (NFPA):
 - 1. NFPA 255 Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. Underwriters Laboratories, Inc. (UL):
 - 1. UL 723 Test for Surface Burning Characteristics of Building Materials.
 - 2. UL Building Materials Directory.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide fire retardant treatment which will perform in accordance with manufacturer's stated performance criteria without defects, damage or failure.

1.5 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Section "Submittals Procedures."
- B. Product Data: Submit product data, including manufacturer's product sheet, for specified products.
- C. Quality Assurance Submittals: Submit the following:
 - 1. Test Report: Certified test report showing compliance with specified performance characteristics and physical properties. Include in test report certification that fire retardant solution does not contain ammonium phosphate.
 - a. Evaluation Report: National Evaluation Report ESR-1626 indicating flamespread, strength, corrosion and hygroscopic properties.
 - 2. Certificate: Certification from treatment plant certifying wood treatment applied complies with Dricon fire retardant treatment by Arch Wood Protection.
- D. Closeout Submittals: Submit the following:
 - 1. Warranty: Warranty documents specified herein.

1.6 QUALITY ASSURANCE

- A. Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section which has specialized in the treatment of wood similar to that required for this project and a plant licensed by Arch Wood Protection.
 - 1. Certificate: When requested, submit certificate indicating qualification.
- B. Regulatory Requirements: Provide fire retardant treatment which complies with the following regulatory requirements:

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 1 Section "Product Requirements."
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

PART 2 - PRODUCTS

2.1 FIRE RETARDANT TREATMENT

- A. Manufacturer: Arch Wood Protection. (Lonza)
 - 1. Contact: 5660 New Northside Dr. NW, Suite 1100
Atlanta, GA 30328
Telephone: (678) 627-2000
- B. Product Treatment: Dricon fire retardant treatment for wood is produced by licensed treatment plant. Fire retardant chemical shall provide protection against termites and fungal decay, shall be registered for use as a wood preservative by the U.S. Environmental Protection Agency (EPA), shall comply with formulation FR-1 of the current edition of AWPA Standard P49, and shall be free of halogens, sulfates and ammonium phosphate. Treated wood shall have a flamespread of less than 25 when tested in an extended 30-minute tunnel test in accordance with ASTM E 84, NFPA 255 or UL 723.
 - 1. Corrosion Properties: Fire retardant treated wood in contact with carbon steel, galvanized steel, aluminum, copper and red brass shall exhibit corrosion rates less than 1 mil (0.025 mm) per year when tested in accordance with Fed. Spec. MIL-L-19140, Paragraph 4.6.5.2.
 - 2. Testing: Testing on fire performance, strength and corrosion properties of fire retardant treated wood shall be recognized by issuance of a National Evaluation Services Report.
- C. Fire Retardant Treatment: Manufacturer's solution for fire retardant treatment of wood.
 - 1. Treatment Standard: Comply with AWPA Standard U1.

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions permitted in accordance with Division 01 provisions, Section 01600 - Materials and Equipment.

2.3 RELATED WOOD MATERIALS

- A. General: Refer to Division 6 Sections for related wood materials specified herein.

2.4 SOURCE QUALITY

- A. Source Quality: Obtain fire retardant treatment from a single manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, for fire retardant treatment installation.

3.2 APPLICATION

- A. Fire Retardant Treatment: Apply a fire retardant treatment in accordance with requirements of applicable codes and manufacturer's requirements.

3.3 PROTECTION

- A. Protection: Protect fire retardant treated wood from damage during construction.

END OF SECTION 06703

SECTION 07115 – BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes cold-applied, emulsified-asphalt dampproofing applied to the following surfaces:
1. Interior face of concealed masonry exterior walls and as indicated on the Drawings or scheduled.
 2. Hollow metal frame bucks, concealed side of door frame.
- B. Related Sections include the following:
1. Division 8 Section "Metal Doors and Frames"
 2. Division 9 Section "Painting"

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cold-Applied, Emulsified-Asphalt Dampproofing:
 - a. ChemMasters Corp.
 - b. DeGusse Building Systems, Sonneborne brand products.
 - c. Gardener Gibson, Inc.
 - d. Henry Company.
 - e. Karnak Corporation.
 - f. Koppers Industries, Inc.
 - g. Malarkey Roofing Company.
 - h. Meadows, W. R., Inc.
 - i. Tamms Industries.

2.2 BITUMINOUS DAMPPROOFING

- A. Cold-Applied, Emulsified-Asphalt Dampproofing:
1. Trowel Coats: ASTM D 1227, Type II, Class 1.
 2. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
 3. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
 4. Product shall be acceptable for use within interior space applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
 - 1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
 - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
- B. Apply dampproofing to provide continuous plane of protection on exterior face of exterior masonry walls.

3.4 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 07115

SECTION 07180 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division / Specification Sections, apply to the Section.

1.2 SUMMARY

- A. This Section includes traffic coatings for the following applications:
 - 1. Hangar floors.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show extent of each traffic coating. Include details for treating substrate joints and cracks, and other termination conditions. Include layout of traffic striping and markings.
- C. Samples: For each type of traffic coating required, prepared on rigid backing. Provide stepped samples on backing large enough to illustrate build-up of traffic coatings.
- D. Material certificates and Installer certifications,
- E. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer (Applicator) Qualifications: Applicator who is certified by manufacturer.
 - 1. Certification: Written approval or license of applicator by traffic coating manufacturer.
- B. Source Limitations: Use traffic coatings of a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of the substrate.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace traffic coatings that fails in materials and workmanship within **five** years from date of Substantial Completion.
 1. Warranty does not include deterioration or failure due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.
 2. Failure includes, but is not limited to, the following:
 - a. Adhesive or cohesive failures.
 - b. Abrasion or tearing failures.
 - c. Surface crazing or spalling.
 - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into substrate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material Compatibility: Provide primers; base, intermediate, and top coats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. VOC Content: Provide waterproofing and traffic paint materials that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Opaque waterproofing treatments: 400 g/L.
 2. Pavement-Marking Paint: 150 g/L
 3. Zone-Marking Coatings: 450 g/L.

2.2 TRAFFIC COATING

- A. Basis-of-Design Product: The design for the vehicle bay floor coating is based on the product indicated below. Products by other listed manufacturers may be considered provided deviations from specifications of the product named are minor as judged by the Architect.
 1. Basis of Design: Dex-O-Tex Division /Crossfield Products Corp.- Aero-Flor III;

2. Delta Polymers Inc.- Polythane 1005;
3. Dur-a-flex Inc.- Poly-thane #3
- B. Primer: Manufacturer's standard factory-formulated primer recommended for substrate and conditions indicated.
- C. Preparatory and Base Coats: Aliphatic Polyurethane coating
- D. Top Coat: Aliphatic Polyurethane coating
 1. Color and Gloss: As selected from manufacturer's full range of pigmented gloss and matte finishes.
- E. Component Coat Thicknesses: As recommended by manufacturer for substrate and service conditions indicated, but not less than 13 mils dry film thickness (measured excluding aggregate):
- F. Aggregate: Uniformly graded washed silica sand of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.
 1. Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated, but not less than the following:
 - a. Top Coat: As required to achieve slip-resistant finish.

2.3 MISCELLANEOUS MATERIALS

- A. Joint Sealants: Multicomponent urethane sealant recommended in writing by manufacturer for substrate and joint conditions indicated and for compatibility with traffic coatings; complying with ASTM C 920.

PART 3 - EXECUTION

3.1 APPLICATION

- A. General: Comply with manufacturer's written recommendations.
- B. Verify compatibility with and suitability of substrates and that substrates are visibly dry and free of moisture.
 1. Application of coating indicates acceptance of surfaces and conditions.
- C. Concrete Substrates: Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed and after surfaces are dry.
 1. Test for moisture by method recommended in writing by manufacturer.

2. Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259. Do not acid etch.
- D. Clean and prepare substrates to produce clean, dust-free, dry substrate for traffic coating application.
 - E. Mask adjoining surfaces not receiving traffic coatings including floor drains, hangar door rails and other substrate penetrations to prevent spillage, leaking, and migration of coatings.
 - F. Prepare, treat, rout, and fill joints and cracks substrates. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
 - G. Start traffic coating application in presence of manufacturer's technical representative.
 1. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft.
 2. Prevent contamination and damage during application and curing stages.

END OF SECTION 07180

SECTION 07190 – WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes clear water-repellent coatings for the following horizontal surfaces:
 - 1. Exterior concrete and concrete walkways, or where noted on the Drawings.

1.3 RELATED 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:
 - 1. Section 03300 – Cast-In-Place Concrete.
 - 2. Section 03481 – Precast Concrete Bollards

1.4 REFERENCES

- A. ACI 308: Standard Specification for Curing Concrete.

1.5 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Product test reports.
- C. Manufacturer's compatibility certification with other sealants and finishes specified.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer (applicator) who employs only persons trained and approved by manufacturer to apply manufacturer's products.
- B. Apply a test sample, 4 feet by 4 feet in area, at designated location for approval prior to initiation of work, and examine concrete surfaces to establish standard of acceptable surface to be sealed.

- C. Pre-Installation Meetings: Conduct meeting at Project site.
 - 1. Schedule and convene meeting a minimum of 2 weeks, prior to commencing Work of this Section.
 - 2. Review requirements for application, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details, installation procedures, testing and inspection procedures, protection, and repair.
 - 3. Discuss procedures for protecting adjacent finished Work.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard for in which Installer agrees to repair or replace water-repellent coatings that fail in materials and workmanship within ten (10) years from date of Substantial Completion. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch in width, fire, vandalism, or abuse by maintenance equipment.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01600 – Materials and Equipment.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Store tightly sealed materials off ground and away from moisture, direct sunlight, extreme heat, and freezing temperatures.
- E. Store in unopened packaging in clean, dry environmental protected from sunlight at 40 degrees F (4 degrees C) to 85 degrees F (29 degrees C) prevent material from freezing.

1.9 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Ensure that substrate surface and ambient air temperature are minimum of 35 degrees F (minus 7 degrees C) and rising at application time and remain above 35 degrees F (minus 7 degrees C) for at least 24 hours after application. Ensure that frost or frozen surfaces are thawed and dry.
 - 2. Do not place surface hardener in areas without roof cover.
 - 3. Allow surfaces to attain temperature and conditions specified before proceeding with surface hardener application.
 - 4. Perform Work of this Section in well-ventilated areas.

PART 2 - PRODUCTS

2.1 WATER REPELLENTS

- A. Silicate: Inorganic silicate-based curing, hardener and dustproofers for use on concrete either interior or exterior. Penetrating water-soluble, water-repellent, clear compound containing water, or other proprietary solvent carrier and densifier, that when applied in accordance with manufacturer's application recommendations will produce dense surface resistance to abrasion, moisture, and tire marking.
1. VOC Requirements: With 0g/L VOCs or less.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF- Kure N Harden ® (Masterkure HD 200 WB)
 - b. Or approved equal, approved and accepted by the Architect and provided substitution complies with specified criteria, and resistant to staining from coffee, sodas, and markers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Preparation: Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water repellent manufacturer's written instructions, to ensure surface is sufficiently dry.
1. Formed Concrete: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.
 2. Clean concrete unit masonry pursuant to NCMA recommendations.
 3. Application of sealer shall be evidence of substrate acceptance.
 4. Remove all concrete fins, splatters, and finished concrete anomalies prior to sealer application.
- B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.
- C. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:
1. Ambient temperature is less than 40 deg F.
 2. Concrete surfaces and mortar have cured for less than 28 days.
 3. Rain or temperatures below 40 deg F are predicted within 24 hours.

4. Application is earlier than 24 hours after surfaces have been wet.
 5. Substrate is frozen or surface temperature is less than 40 deg F.
 6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.
- D. Protect adjoining work including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- E. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the Work.
- F. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare small application in an unobtrusive location and in a manner approved by Architect to demonstrate final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.
1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute departure from requirements of the Contract Documents at time of contracting.
- G. Apply heavy saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- H. Apply second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.
- I. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage cause by water-repellent application. Comply with manufacturer's written cleaning instructions. Do allow residue to dry on the concrete surface or allow staining (white residue) to form.
- J. After application is complete, remove protective coverings from adjacent surfaces and other protected areas.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve substrate before application and to instruct applicator on product and application method to be used.

END OF SECTION 07190

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Mineral-wool board insulation.
 - a. Reference Drawings for UL Design options and assemblies for applicability of this product.
- 2. Rigid board foam (closed cell) insulation.
- 3. Mineral-wool blanket insulation.
 - a. Reference Drawings for UL Design options and assemblies for applicability of this product.
- 4. Spray polyurethane foam insulation.
- 5. Sound batt insulation.

- B. Related Sections:

- 1. Division 7 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including, but not limited to installation instructions and attachment devices.
- B. Manufacturer's Certification: Manufacturer's certification that product complies with the project requirements and is suitable for the use intended.
- C. Manufacturer's Thermal Performance Warranty.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Manufacturer will maintain quality control during manufacturing so that the insulating product will perform as specified in test reports and ratings given in manufacturer's printed material.
- C. Interior Wall Insulation shall not be produced with, or contain, any of the United States EPA regulated CFC compounds listed in the Montreal Protocol of the United Nations Environmental Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. All materials shall be delivered to the project site in their original unbroken containers, bearing the manufacturer's name, brand and specification designation.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BOARD INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Isolatek International.
 - 2. Owens Corning.
 - 3. Thermafiber.
- B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Nominal density of 6 lb/cu. ft., Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 2. Fiber Color: Darkened, where indicated.

2.2 RIGID BOARD FOAM (CLOSED CELL) INSULATION

- A. Basis-of-Design: Subject to compliance with requirements, provide The Dow Chemical Company; Styrofoam Brand Z-Mate Extruded Polystyrene Foam Insulation.
- B. Material Properties:
 - 1. Rigid closed-cell extruded polystyrene foam insulation.
 - 2. Comply with ASTM C 578-95, Type X, density 1.35 lb/cu. ft. min., compressive strength 15 psi (ASTM D 1621-94).
 - 3. Thermal resistance: 5-year aged R-values of 5.4 and 5.0 min. °F-ft²-h/Btu²/inch at 40°F and 75° respectively (ASTM C 518-91).
 - 4. Water absorption: Max. 0.1% by volume (ASTM C 272-91).
 - 5. Surface Burning Characteristics:
 - a. Flame Spread: 5 or less.
 - b. Smoke Developed: 165.
- C. Thickness: (R-5)/inch; Refer to Drawings for composite "R" value of the assembly.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Guardian Building Products, Inc.
 - 2. Johns Manville.
 - 3. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.4 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fibrex Insulations Inc.
 - 2. Owens Corning.
 - 3. Thermafiber.
 - 4. Johns Manville.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without

membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.5 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. BASF Corporation.
 - c. Henry Company.
 2. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.6 SOUND ATTENUATION BATTS

- A. Sound attenuation batts shall be unfaced glass fiber insulation and have been tested in accordance with ASTM C665, Type 1, ASTM E-84 and ASTM C-423, as manufactured by Owens Corning Corp. or approved equal.
- B. Material thickness and locations shall be, but not limited to, the following:
1. 2-12 inch thick (NRC = .85): for all waste and drain pipes, and rainwater leaders in all walls.
 2. 3-1/2 inch thick (NRC = 1.05): for sound walls, dropped ceilings of that same space as above, dropped ceilings at all bathrooms, and conference rooms, at a minimum. Refer to Drawings for extent.

2.7 ACOUSTICAL SEALANT (CAULKING)

- A. Sealant shall be a non-hardening, non-drying and non-bleeding acoustical sealant as manufactured by TREMCO Sealant Systems or USG Sealant for use at sound walls only.

2.8 STYROFOAM PANELS

- A. Styrofoam panels shall be STYROFOAM 60 High Load (roofs) and Square Edge XPS (walls), in 2.5 inch thickness as manufactured by Dupont or approved equal.

2.9 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with

self-locking washer in place.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.
1. Product: Subject compliance with requirements, provide one of the following:
 - a. Gemco; Clutch Clip.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.
- B. Verify that masonry joints are struck flush and that other conditions are satisfactory for proper installation.
- C. Remove concrete fins and mortar projections that interfere with placement of insulation boards.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left

exposed to ice, rain, or snow at any time.

- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Mineral-Wool Insulation: Reference Drawings for UL Design options and assemblies for installation of mineral-wool insulation as required.
- C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed, and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 INSTALLATION OF BOARD INSULATION

- A. Install board insulation where indicated on Drawings according to manufacturer's written instructions.
 - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place. Maintain cavity width of dimension indicated between insulation and wall face.
 - 2. Install 2-furring channels vertically at 24" o.c., fit insulation boards between the furring channels.
 - 3. Insulate around plumbing fixtures with a compatible spray foam insulation.
 - 4. Seal the space between STYROFOAM Brand Z-MATE Extruded Polystyrene Foam Insulation and window frames with latex acrylic sealant.

3.5 INSTALLATION OF SOUND ATTENUATION BATTS

- A. Sound batts shall be installed between metal studs continuous from floor slab to bottom of slab at ceiling.
- B. Wrap and tape around piping, conduit, and duct work to provide an unbroken barrier.
- C. Batts shall be butted tight at all joints and securely put into place.
- D. Extend & overlap sound batts a minimum of 4'-0" beyond face of sound rated walls that do not extend to the structure.

3.6 INSTALLATION OF ACOUSTICAL SEALANT

- A. Install sealant around perimeters of all code required fire rated sound-rated wall, including vertical surfaces, floors and ceilings.
- B. Install sealant around all electrical outlet and switch boxes, and where pipes and conduit pass through code required sound-rated walls.

3.7 INSTALLATION OF STYROFOAM PANELS

- A. STYROFOAM 60 High Load (roofs) and Square Edge XPS (walls) shall be installed as detailed, shown and/or indicated on the drawings or as specified; roof applications shall comply with wind load requirements.

3.8 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at NO EXTRA COST to the Owner.

3.9 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 07250 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Weather barrier membrane system.
- B. Fasteners

1.3 REFERENCES

- A. ASTM International
 - 1. ASTM C 920; Standard Specification for Elastomeric Joint Sealants
 - 2. ASTM C 1193; Standard Guide for Use of Joint Sealants
 - 3. ASTM D 882; Test Method for Tensile Properties of Thin Plastic Sheeting
 - 4. ASTM D 1117; Standard Guide for Evaluating Non-woven Fabrics
 - 5. ASTM E 84; Test Method for Surface Burning Characteristics of Building Materials
 - 6. ASTM E 96; Test Method for Water Vapor Transmission of Materials
 - 7. ASTM E 1677; Specification for Air Retarder Material or System for Framed Building Walls
 - 8. ASTM E2178; Test Method for Air Permeance of Building Materials
 - 9. ASTM E2357; Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- B. AATCC – American Association of Textile Chemists & Colorists
 - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test
- C. TAPPI
 - 1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
 - 2. Test Method T-460; Air Resistance of Paper (Gurley Hill Method)

1.4 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures.

- B. Product Data: Submit manufacturer current technical literature for each component of the system.
- C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.
- D. Quality Assurance Submittals
 - 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 - 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.
 - 3. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.
- E. Closeout Submittals
 - 1. Refer to Section 01780 Closeout Submittals.
 - 2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion. Warranty period 10 years.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Installer shall have experience with installation of weather barrier assemblies under similar conditions.
 - 2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
 - 3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 Product Requirements.
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by weather barrier manufacturer.

1.7 SCHEDULING

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of other building elements and flashings to provide a weather-tight barrier assembly.

- B. Schedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

1.8 WARRANTY

- A. Refer to Section 01740 Warranties and Bonds, and Section 01770 Closeout Procedures.
- B. Special Warranty
 - 1. Weather barrier manufacturer's warranty for weather barrier for a period of ten (10) years from date of purchase.
 - 2. Pre-installation meetings and jobsite observations by weather barrier manufacturer for warranty is required prior to assembly installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://www.construction.tyvek.com>
- B. Basis of Design: spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® D and related assembly components and accessories, or equal approved by the Architect. Dupont™ fluid applied “WB+” weather barrier and flashings will be acceptable in lieu of weather barrier wrap material/sheet.
- C. Performance Characteristics:
 - 1. Air Penetration: 0.001 cfm/ft² at 75 Pa when tested in accordance with ASTM E2178. Type 1 when tested in accordance with ASTM E 1677. ≤0.04 cfm/ft @ 75 Pa when tested in accordance with ASTM E2357.
 - 2. Water Vapor Transmission: 30 perms, when tested in accordance with ASTM E 96, Method B.
 - 3. Water Penetration Resistance: 235 cm when tested in accordance with AATCC Test Method 127.
 - 4. Basis Weight: 2.4 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 - 5. Air Infiltration Resistance: Air infiltration at >750 seconds, when tested in accordance with TAPPI Test Method T-460.
 - 6. Tensile Strength: 33/41 lbs/in., when tested in accordance with ASTM D 822 , Method A.
 - 7. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 15, Smoke Developed: 25.

- D. Other manufacturers and product substitutions will be considered for approval in accordance with Section 01600 Materials and Equipment, and that are approved by the Architect.

2.2 ACCESSORIES

- A. Seam Tape: 3" DuPont™ Tyvek® Tape as distributed by DuPont or Architect approved weather barrier manufacturer's seam tape, or fluid applied flashings for the sprayed-fluid applied weather barrier system.

- B. Fasteners:

- 1. Steel Frame Construction DuPont™ Tyvek® Wrap Cap Screws: 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap fasteners, or Architect approved weather barrier manufacturer's fastener and cap screw system.

- C. Sealants

- 1. Refer to Section 07920 Joint Sealants for additional requirements.
 - 2. Provide sealants that comply with ASTM C 920, elastomeric polymer sealant to maintain watertight conditions.
 - 3. Products:
 - a. DuPont™ Commercial Sealant.
 - b. Sealants recommended by the weather barrier manufacturer.

- D. Adhesives:

- 1. Provide adhesive recommended by weather barrier manufacturer.
 - 2. Products:
 - a. Liquid Nails® LN-109
 - b. Denso Butyl Liquid
 - c. 3M High Strength 90
 - d. Adhesives recommend by the weather barrier manufacturer.

- E. Primers:

- 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
 - 2. Products:
 - a. 3M High Strength 90
 - b. Denso Butyl Spray
 - c. Permagrip 105
 - d. Primers recommended by the flashing manufacturer

- F. Flashing, as required to meet manufacturer's system assembly for complete system. Flashings listed below are based on the Basis of Design, provide approved weather barrier manufacturer flashings.
1. DuPont™ FlexWrap™: Flexible membrane flashing materials for window openings and penetrations.
 2. DuPont™ FlexWrap™ NF: Flexible membrane flashing materials for window openings and penetrations.
 3. DuPont™ StraightFlash™: Straight flashing membrane materials for flashings and sealing penetrations such as masonry ties, etc.
 4. DuPont™ Thru-Wall Surface Adhered Membrane with Integrated Drip Edge: Thru-Wall flashing membrane materials for flashing at changes in direction or elevation (shelf angles, foundations, etc.) and at transitions between different assembly materials.
 5. Preformed Inside and Outside Corners and End Dams as distributed by DuPont: Preformed three-dimensional shapes to complete the flashing system used in conjunction with DuPont™ Thru-Wall Flashing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 INSTALLATION - WEATHER BARRIER

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
- B. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- C. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level
- D. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
- E. Openings: Extend weather barrier completely over openings.
- F. Overlap weather barrier
1. Exterior corners: minimum 12 inches.
 2. Seams: minimum 6 inches.

G. Weather Barrier Attachment:

1. Framed Construction: Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 6 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

- H. Apply 4 inch by 7 inch piece of weather barrier flashing manufacturer approved alternate to weather barrier membrane prior to the installation cladding anchors.

3.3 SEAMING

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.4 OPENING PREPARATION

- A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

3.5 FLASHING

- A. Install flashing in accordance with manufacturer's requirements and standards. Coordinate flashing with other building elements.
- B. Cut 9-inch wide DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF a minimum of 12 inches longer than width of sill rough opening.
- C. Cover horizontal sill by aligning DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- D. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges. Mechanically fastening DuPont™ FlexWrap™ NF is not required.
- E. Apply 9-inch wide strips of DuPont™ StraightFlash™ at jambs. Align flashing with interior edge of jamb framing. Start StraightFlash™ at head of opening and lap sill flashing down to the sill.
- F. Spray-apply primer to top 6 inches of jambs and exposed sheathing.

- G. Install DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
- H. Coordinate flashing with other building elements.
- I. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.

3.6 THRU-WALL FLASHING INSTALLATION

- A. Apply primer per manufacturer's written instructions.
- B. Install preformed corners and end dams bedded in sealant in appropriate locations along wall.
- C. Starting at a corner, remove release sheet and apply membrane to primed surfaces in lengths of 8 to 10 feet.
- D. Extend membrane through wall and leave ¼ inch minimum exposed to form drip edge.
- E. Roll flashing into place. Ensure continuous and direct contact with substrate.
- F. Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.
- G. Trim exterior edge of membrane 1-inch and secure metal drip edge per manufacturer's written instructions.
- H. Terminate membrane on vertical wall. Terminate into reglet, counterflashing or with termination bar.
- I. Apply sealant bead at each termination.

3.7 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT BASE OF WALL

- A. Overlap thru-wall flashing with weather barrier by 6-inches.
- B. Mechanically fasten bottom of weather barrier through top of thru-wall flashing.
- C. Seal vertical and horizontal seams with tape or sealing membrane.

3.8 FIELD QUALITY CONTROL

- A. Notify manufacturer's designated representative to obtain periodic observations of weather barrier assembly installation.

3.9 PROTECTION

- A. Protect installed weather barrier from damage.

END OF SECTION 07250

SECTION 07260 - VAPOR RETARDER

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Products supplied under this section:
 - 1. Vapor barrier and installation accessories for installation under concrete slabs.

1.2 SUMMARY

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as shown, noted, detailed, necessary and reasonably implied on the drawings and specifications at all new cast-in-place slab on grade concrete floors and pavement.
- B. Where existing concrete slab-on-grade floors are removed or demoed for new work, install new vapor retarder.

1.3 RELATED SECTIONS

- A. Section 02361 – Termite Control
- B. Section 03300 – Cast-in-place Concrete

1.4 REFERENCES

- A. ASTM D 882 – Tensile Properties of Thin Plastic Sheeting.
- B. ASTM D 1709 – Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- C. ASTM D 2582 – Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
- D. ASTM D 3776 – Mass per Unit Area (Weight) of Woven Fabric.
- E. ASTM D 4833 – Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
- F. ASTM E 96 – Water Vapor Transmission of Materials.
- G. ASTM E 1643 – Installation of Water Vapor Retarders Used in Contact with Earth

or Granular Fill Under Concrete Slabs.

- H. ASTM E 1745 – Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- I. ACI 302.2R-06 – Guide for Concrete Slabs that Receive Moisture Sensitive Flooring Materials.

1.5 SUBMITTAL DATA AND SAMPLES

- A. Submit product data under provisions of Section 01300 – Shop Drawings, Product Data and Samples.
- B. Submit manufacturer's data describing products, product samples, installation procedures, a schedule of locations, and details of joint and construction penetrations.
 - 1. Summary of test results per paragraph 9.3 of ASTM E 1745.
 - 2. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.
 - 3. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

1.6 STORAGE AND PROTECTION

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and protection shall be in accordance with Section 01600 – Materials and Equipment.

1.7 WARRANTY

- A. Refer to Section 01740 – Warranties and Bonds.

PART 2 – PRODUCTS

2.1 MEMBRANE VAPOR RETARDER

- A. Comply with applicable portions of the Florida Building Code for minimum requirements for vapor barriers and dampproofing.
- B. Provide products from the manufacturers listed below. Products of other manufacturers will be considered under standard substitution procedures. See Section 01600 – Materials and Equipment.
- C. Underslab Membrane:
 - 1. Vapor barrier shall have all of the following qualities:

- a. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
- b. Other performance criteria:
 - 1) Strength: ASTM E1745 Class A.
 - 2) Thickness: 15 mils minimum
2. Basis-of-Design Product: Stego Wrap 15 mil. Underslab membrane by Stego Industries, LLC; www.stegoindustries.com, 1-877-464-7834.
3. Alternate Manufacturer's:
 - a. Griffolyn Vaporguard by Reef Industries, Inc.
 - b. Perminator- 15mil. by W.R. Meadows
 - c. Other Manufacturers approved by the Architect.
- D. Seem/Penetration & Perimeter Tape: Polyethylene, self-adhering type, 2-inches wide, compatible with sheet material as recommended by the membrane manufacturer. Perimeter tape shall be manufacturer's standard double-sided, or term bar may be used. Do not use Duct Tape; Provide manufacturer's approved system components.
- E. Mastic: Manufacturer's standard mastic or sealant.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. All items in this Section shall be installed by experienced mechanics of this trade, in the best workmanlike manner of this trade's best standard practice and in strict accordance with the manufacturer's printed instructions.

3.2 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 1. Level and compact base material.

3.3 VAPOR RETARDER INSTALLATION

- A. Vapor retarder shall be placed over firmly compacted fill, lapping in direction concrete will be placed. Lap a minimum of 6 inches and seal laps, edges and cuts water tight with self-adhering tape. Place reinforcing steel and electrical conduit above membrane. If any tears result, mend with self-adhering tape sealed down watertight.

- B. Vapor retarder for walls shall be placed and anchored per manufacturers recommendations and lapped a minimum of 6 inches and sealed, edges and cuts water tight with self-adhering tape.

3.4 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and replaced with new material in the best workmanlike manner at no extra cost to the Owner.

END OF SECTION 07260

SECTION 07620 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Formed Products:

- a. Formed low-slope roof sheet metal fabrications.
 - b. Formed overhead-piping safety pans.

- B. Related Sections:

- 1. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
 - 2. Division 7 Section "Roof Accessories" for equipment supports, vents, and other manufactured roof accessory units.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 4. Details of termination points and assemblies, including fixed points.
 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 7. Details of special conditions.
 8. Details of connections to adjoining work.
 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 3. Accessories and Miscellaneous Materials: Full-size Sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
 - 1. Finish: Brushed.
 - 2. Surface: Smooth, flat.

- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: Smooth, flat and mill phosphatized for field painting.
 2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable

for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
4. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.
- I. Do not use segments to fabricate arches. Provide seams where indicated on Drawings.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Base Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick.
- B. Counterflashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick.
- C. Flashing Receivers: Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or

install a course of polyethylene sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel and aluminum sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of

snap-in installation and sealant or lead wedges and sealant or interlocking folded seam or blind rivets and sealant and anchor and washer at 36-inch centers at concealed conditions (not visible from public view).

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

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SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Equipment supports.
2. Equipment pipe supports and conduit sleeves.
3. Preformed flashing sleeves.
4. Square/rectangular, elbows, and offsets gutters.
5. Precast splash blocks.
6. Gutter & rain chains.

- B. Related Sections:

1. Division 5 Section "Metal Fabrications".
2. Division 7 Section "Metal Roof Panels".

1.3 REFERENCES

- A. ASTM International (ASTM):

1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A527 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
3. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
4. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM B6 - Standard Specification for Zinc.
6. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 - 4. Required clearances.
- B. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.8 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section shall be supplied by a single manufacturer with a minimum of ten years' experience.

- B. Installer Qualifications: Minimum 2 years experience installing similar products.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Store products in clean, dry, sheltered area off the ground until ready for use.

1.11 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.2 GUTTERS & RAIN CHAINS

- A. Basis of Design: Chris Industries, located at: 290 Larkin Ave.; Wheeling, IL 60090; Toll

Free Tel: 800-356-7922 ; Tel: 847-729-9292; Fax: 847-729-0340;
Web:www.chrisind.com

- B. Size as indicated on drawings.
- C. Alternate manufacturers shall include:
 - 1. Architectural Products Company
 - 2. AMSI - Supply.
 - 3. or Architect approved equal.
- D. Requests for substitutions will be considered in accordance with provisions of the General Requirements and Specifications.
- E. Gutter Materials: The finishes listed in this specification are made using materials listed below as applicable and as specified.
 - 1. Aluminum: Kynar Painted Flat Sheet: Alloy 3105-H15. ASTM B209.
- F. Rain Chain: materials:
 - 1. Rain Chain links:
 - a. 316 stainless steel
 - 2. Installation Base
 - a. Aluminium
- G. Precast Concrete Splash Blocks:
 - 1. Precast concrete splash block 10" wide by 24" long; reinforces Grey concrete:4000 PSI @ 28 days as manufacturer by Commercial Concrete Products, Inc. or architect approved equal, with stainless steel rain chain – epoxy set eye bolt

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.
- C. Board Insulation: ASTM C 1289, thickness as indicated, to match roof insulation.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic

or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals or wood blocking, or curbs being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads and FBC wind loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant (as required by roof manufacturer) raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thaler Metal USA, Inc.
 - b. Custom Solution Roof and Metal Products.
 - c. LM Curbs.
 - d. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - e. Roof Products, Inc.
 - f. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported. Provide a minimum of 1'-0" clear above roof to bottom of support frame.

- C. Loads: As indicated on Drawings.
- D. Material: Aluminum sheet, 0.090 inch thickness as required to meet or exceed loading requirements.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.5 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high above roof surface, with removable metal hood and slotted metal collar.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Custom Solution Roof and Metal Products.
 - b. Thaler Metal USA Inc.
 - 2. Metal: Aluminum sheet, 0.063 inch thick.
 - 3. Diameter: As indicated on Mechanical Drawings.
 - 4. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Custom Solution Roof and Metal Products.
 - b. Thaler Metal USA Inc.
 - 2. Metal: Aluminum sheet, 0.063 inch thick.
 - 3. Height: 13 inches.
 - 4. Diameter: As indicated on Mechanical Drawings.
 - 5. Finish: Manufacturer's standard.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- D. Equipment Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.
- E. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.
- F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 9 painting Sections.
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07720

SECTION 07841 - PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

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

- B. Related Sections:

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

1.3 ACTION SUBMITTALS

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

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

- 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Engineer must be registered in the State of Florida.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

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

recommendations.

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A single professional firestopping installation firm for the entire Building with penetration firestopping experience on similar applications in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) FM Global in its "Building Materials Approval Guide."
- C. Pre-installation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grace Construction Products.
 - 2. Hilti, Inc.
 - 3. Specified Technologies Inc.
 - 4. 3M Fire Protection Products.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Horizontal assemblies include floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.

3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.

2.3 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

- C. Install fill materials for firestopping by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with permanent preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping.

Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

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

3.5 CLEANING AND PROTECTION

- A. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing FS-MP-1:
1. UL-Classified Systems: C-AJ- 1226.
 2. F-Rating: 3 hours.
 3. L-Rating at Ambient: Less than 1 cfm/sq. ft..

4. W-Rating: No leakage of water at completion of water leakage testing.
- C. Firestopping for Metallic Pipes, Conduit, or Tubing FS-MP-2:
1. UL-Classified Systems: W-L-1054.
 2. F-Rating: 1 and 2 hours.
 3. L-Rating at Ambient: Less than 1 cfm/sq. ft..
 4. W-Rating: No leakage of water at completion of water leakage testing.
- D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing FS-NMP-1:
1. UL-Classified Systems: C-AJ- 2109.
 2. F-Rating: 2 hours and 3 hours.
 3. T-Rating: 0, 2, 3 hours.
 4. W-Rating: No leakage of water at completion of water leakage testing.
- E. Firestopping for Nonmetallic Pipe, Conduit, or Tubing FS-NMP-2:
1. UL-Classified Systems: W-L- 2078.
 2. F-Rating: 1 hour and 2 hours.
 3. T-Rating: 0, 1, 2 hours.
 4. W-Rating: No leakage of water at completion of water leakage testing.
- F. Firestopping for Cable Trays with Electric Cables FS-CT-1:
1. UL-Classified Systems: W-J- 4009.
 2. F-Rating: 2 hours.
- G. Firestopping for Cable Trays with Electric Cables FS-CT-2:
1. UL-Classified Systems: W-L- 4005.
 2. F-Rating: 1 and 2 hours.
- H. Firestopping for Insulated Pipes FS-IMP-1:
1. UL-Classified Systems: C-AJ- 5198.
 2. F-Rating: 2 hours.
 3. T-Rating: 0 and ½ Hour.
 4. W-Rating: No leakage of water at completion of water leakage testing.
- I. Firestopping for Insulated Pipes FS-IMP-2:
1. UL-Classified Systems: C-AJ- 5301.
 2. F-Rating: 2 hours.
 3. T-Rating: 0 and 1½ Hours.
 4. W-Rating: No leakage of water at completion of water leakage testing.
- J. Firestopping for Insulated Pipes FS-IMP-3:
1. UL-Classified Systems: W-L- 5029.
 2. F-Rating: 1 and 2 hours.

3. T-Rating: $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$ and $1\frac{3}{4}$ hours.
 4. W-Rating: No leakage of water at completion of water leakage testing.
 5. L-Rating at Ambient: 4 cfm/sq ft
- K. Firestopping for Insulated Pipes FS-IMP-4:
1. UL-Classified Systems: W-L- 5028.
 2. F-Rating: 1 and 2 hours.
 3. T-Rating: $\frac{3}{4}$, hours.
 4. W-Rating: No leakage of water at completion of water leakage testing.
 5. L-Rating at Ambient: less than 1 cfm/sq ft
- L. Firestopping for Miscellaneous Mechanical Penetrants FS-MDC-1:
1. UL-Classified Systems: W-J- 7089.
 2. F-Rating: 2 hours.
 3. T-Rating: 0 hour.
 4. L-Rating at Ambient: Less than 1 cfm/sq. ft.
- M. Firestopping for Miscellaneous Mechanical Penetrants FS-MDC-2:
1. UL-Classified Systems: W-L- 7149.
 2. F-Rating: 2 hours.
 3. T-Rating: 0 hour.
 4. L-Rating at Ambient: Less than 1 cfm/sq. ft..
- N. Firestopping for Groupings of Penetrants FS-MLP-1:
1. UL-Classified Systems: C-AJ- 1048.
 2. F-Rating: 3 hours.
 3. T-Rating: $\frac{1}{2}$ hour.
 4. L-Rating at Ambient: Less than 1 cfm/sq. ft..
 5. W-Rating: No leakage of water at completion of water leakage testing.
- O. Firestopping for Groupings of Penetrants FS-MLP-2:
1. UL-Classified Systems: W-L- 1173.
 2. F-Rating: 3 and 4 hours.
 3. T-Rating: 1 hour.
 4. L-Rating at Ambient: Less than 1 cfm/sq. ft..

END OF SECTION 07841

SECTION 07844 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.
- B. Related Sections:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Engineer must be registered in the State of Florida.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A single professional firm for the entire project with experience in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- C. Pre-installation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. Specified Technologies Inc.
 - c. 3M Fire Protection Products.
- C. Joints at Exterior Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg or ASTM E 2307.
1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. Specified Technologies Inc.
 - c. 3M Fire Protection Products.
 - d. Thermafiber, Inc.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. Specified Technologies Inc.
 - c. 3M Fire Protection Products.

- E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without

disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with a permanent preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with

requirements.

- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

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

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated or as required to maintain ratings, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Wall-to-Wall, Concrete to concrete or CMU Fire-Resistive Joint Systems FRJS-1:
 - 1. UL-Classified Systems: WW-D- 0001.
 - 2. Assembly Rating: 1, 2 and 3 hour.
 - 3. Nominal Joint Width: 1 inch.
 - 4. Movement Capabilities: Class II - 12.5 percent compression or extension.
 - 5. L-Rating at Ambient: Less than 1 cfm/ft..
- C. Wall-to-Wall, Gypsum / Concrete or CMU Fire-Resistive Joint Systems FRJS-2:
 - 1. UL-Classified Systems: WW-S- 0052.
 - 2. Assembly Rating: 1, 2 and 3 hour.
 - 3. Nominal Joint Width: 1 inch.
 - 4. L-Rating at Ambient: Less than 1 cfm/ft..
- D. Floor-to-Wall, Concrete Floor to Concrete or CMU Wall; Fire-Resistive Joint Systems FRJS-3:
 - 1. UL-Classified Systems: FW-D-0023.
 - 2. Assembly Rating: 1 hour 2 hours.
 - 3. Nominal Joint Width: 2 inches.
 - 4. Movement Capabilities: Class II - 19 percent compression or extension.
 - 5. L-Rating at Ambient: Less than 1 cfm/ft..
- E. Head-of-Wall, CMU or Concrete Partitions; Fire-Resistive Joint Systems FRJS-HWD-

CMU:

1. UL-Classified Systems: HW-D-1034.
2. Assembly Rating: 1 hour to 3 hour.

F. Head-of-Wall, gypsum Partitions; Fire-Resistive Joint Systems FRJS-HWD-GWB:

1. UL-Classified Systems: HW-D-0043.
2. Assembly Rating: 1 hour to 2 hour.

G. Perimeter Fire-Resistive Joint Systems PFRJS-1:

1. UL-Classified Perimeter Fire-Containment Systems: CW- S-2034.
2. Integrity Rating: 1 ½ to 2 hours.
3. Insulation Rating: 1/4 hour.
4. Linear Opening Width: 8 inches, maximum.
5. L-Rating at Ambient Temperature: Less than 1 cfm/ft..

H. Perimeter Fire-Resistive Joint Systems PFRJS-2:

1. UL-Classified Perimeter Fire-Containment Systems: CW- S-20349.
2. Integrity Rating: 1 ½ to 2 hours.
3. Insulation Rating: 1/4 hour.
4. Linear Opening Width: 8 inches, maximum.
5. L-Rating at Ambient Temperature: Less than 1 cfm/ft..

I. Perimeter Fire-Resistive Joint Systems PFRJS-3:

1. UL-Classified Perimeter Fire-Containment Systems: CW- S-2044.
2. Integrity Rating: 1 ½ to 2 hours.
3. Insulation Rating: 1/4 hour.
4. Linear Opening Width: 8 inches, maximum.
5. L-Rating at Ambient Temperature: Less than 1 cfm/ft..

END OF SECTION 07844

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SECTION 07900 - CAULKING AND SEALANTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as noted, detailed, necessary, and reasonably implied on the drawings and in the specifications.

1.3 RELATED 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:
 - 1. Section 07210 – Sound Reduction Sealants.
 - 2. Section 07841 – Penetration Firestop Systems.
 - 3. Section 08905 – Window Walls and Exterior Glazing.
 - 4. Divisions 15 and 16, Mechanical, Plumbing, Fire Protection, Electrical.

1.4 DEFINITIONS

- A. "Caulking Compound" shall apply only to materials and work in connection with the filling or closing of interior joints where expansion or contraction are of no consideration, and where filling and closing of these interior joints are primarily for appearance.
- B. "Sealant" shall apply to materials and work to seal and make watertight all joints on the exterior of the building and joints on the interior of the building that may be expected to expand and contract.
- C. "Silicone" shall apply to glazing systems including perimeter, butt joint, structural, storefront, and metal curtainwall.
- D. "Mildew Resistant Sealant" shall apply to sealant to be applied to all interior tiled joints or other non-porous substrates that are subject to in-service exposures of high humidity and temperature extremes.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 01300 – Shop Drawings,

Product Data, and Samples.

- B. Complete data sheets clearly identifying all materials, specifications and locations where they are proposed for use in this project.
- C. Manufacturer's printed data, specifications, and installation procedures.
- D. Manufacturer's compatibility statement that sealant bonding surfaces and materials are acceptable surfaces for proposed sealant and surface preparation requirements, including priming and cleaning criteria.
- E. Manufacturer's field pull test for existing adhesion, stain and primer requirements for each sealant application and sealant surface. Pull test shall be conducted in accordance with ASTM standards.

1.6 WARRANTY

- A. Refer to Section 01700 - Project Closeout, Detail Requirements. Provide a warranty covering sealant materials and joint failure.
- B. Joint failure is defined as:
 - 1. Leaks of air or water.
 - 2. Evidence of loss of cohesion - cohesive failure.
 - 3. Fading of sealant material beyond manufacturer's standard printed Criteria.
 - 4. Migration of sealant.
 - 5. Evidence of loss of adhesion between sealant and joint edge - adhesive failure.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.
- B. Deliver materials in their original unbroken containers, bearing the manufacturer's name and brand designation and specification number where applicable. Caulking compound, sealant, or components more than 6 months old shall not be used.

1.8 SCOPE

- A. The work includes caulking and sealing all portions of new construction.
- B. Specific materials and areas to be caulked or sealed include, but are not limited to, the following:
 - 1. Door and window opening frames at interior and exterior of building

2. Door thresholds at exterior of building
3. Intersection of dissimilar materials at interior and exterior floors, walls, stairs, and ceilings of the buildings
4. Intersection or termination of specialty materials such as granite countertops, marble, tile, etc.
5. Stucco joints and accessories
6. Sheet metal work other than flashings
7. Joint conditions as directed by the Architect

PART 2 – PRODUCTS

2.1 CAULKING

- A. Interior, air-conditioned areas, caulking compound shall be acrylic latex type, ASTM C834. Provide one of the following:
 1. GE – RCS20
 2. Sonneborn “Sonolac.”
 3. Pecora “AC-20.”
 4. Bostik “Chem-Calk 600/650.”
 5. Tremco “Tremflex 834.”

2.2 ELASTOMERIC SEALANTS

- A. Provide single-component or multi-component, low-modulus, non-sag polyurethane sealant that is suitable for continuous immersion in water; comply with ASTM C920, Type S or M, Grade NS, Class 25.
 1. Acceptable Sealants:
 - a. Tremco “Vulkem 116/921/922.”
 - b. Tremco, “Dymeric 511.”
 - c. Bostik “Chem Caulk 900.”
 - d. Pecora “Dynatrol 1.”
 - e. Sika “Sikaflex 1A,” Sikaflex 2cNS”, or “Sikaflex 15LM
- B. Provide single-component or multi-component polyurethane sealant having a Shore A hardness of not less than 25, or more than 50, and plus-or-minus 25 percent joint movement capability that is suitable for continuous immersion in water; comply with ASTM C920, Type S or M, Grade P or NS, Class 25.

1. Acceptable Sealants:
 - a. Tremco "Vulkem 45/245/227."
 - b. Tremco "THC 900/901."
 - c. "Sikaflex-1a" or "Sikaflex-2c NS/SL"
- C. Sealant shall meet ASTM C 920 for one part and two-part polysulfide base sealants.
 1. Pecora "GC-9 Synthacalk," one part.
 2. Pecora "GC-5 Synthacalk," two part.
 3. Sonneborn "Sonolastic Sealant," one part or two part.
 - a. Color of sealants as selected by Architect from manufacturer's standard colors.

2.3 MILDEW RESISTANT SEALANT (INTERIOR WET AND TILED AREAS)

- A. One-Part, Mildew-Resistant Silicone Sealant: ASMT C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. Products: Subject to compliance with requirements, provide one of the following products:
 1. Dow Corning "Dow Corning 786."
 2. GE Silicones "Sanitary 1700."
 3. Pecora "Pecora 898 Sanitary Silicone Sealant."

2.4 SILICONE

- A. Silicone sealants shall meet ASTM C 920.
- B. Silicone shall be as manufactured by G.E., or Dow Corning, or Sika as recommended by the manufacturer as appropriate for the intended use.
- C. Color as selected by the Architect.

2.5 PENETRATION SEALANT/FIRE RATED SEALANT SYSTEMS

- A. See Section 07840 – Firestopping (Penetration Seals).

2.6 BOND BREAKERS

- A. Bond breakers where required by sealant manufacturer.

2.7 PRIMER

- A. Primers for joint groove shall be primers recommended by the caulking or sealant manufacturer as being required to seal the pores in the materials, the sides of the joint grooves, and as being compatible with the caulking or sealant being used.

2.8 BACKER MATERIAL

- A. Backing material shall be a closed cell non-staining polyethylene in round or square shape as recommended by the manufacturer of the compound. Materials shall be free from oil or other staining elements. Oakum and other types of absorptive or open cell materials shall not be used.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. All items in this Section shall be installed by experienced skilled mechanics in the best workmanlike manner of the trade's best standard practice and in strict accordance with approved submittals.

3.2 JOINT DIMENSIONS

- A. Depth of joint is defined as distance from outside face of joint to closest point of joint filler, whether joint filler is rod shaped or rectangular shaped.
- B. Joints: Depth and width as required and confirmed by product manufacturer but no less than the following requirements.
 - 1. Joints: Never less than 1/8 inch depth by 1/4 inch width, unless specifically approved by Architect.
 - 2. For joints in concrete or masonry, depth of sealant must be 1/2 of the width of joint up to 1/2 inch wide. For expansion, other joints exceeding 1/2 inch in width, depth of sealant: no greater than 1/2 sealant width.
 - 3. For joints in non-porous surfaces, metal, glass, sealant depth: minimum of 1/2 sealant width, in no case exceeding sealant width.
 - 4. Contractor shall determine/verify that joint dimension limits noted above and required by the joint sealant manufacturer are met.

3.3 JOINT INSPECTION

- A. Building joints shall be examined prior to application and any conditions detrimental to achieving a positive, weather-tight seal shall be reported to the General Contractor and the Architect.

- B. All openings, joints, or channels to be sealed shall be thoroughly clean, dry, and free from dust, oil, grease, loose mortar, or any other foreign matter.
- C. Surfaces with protective coatings that the sealant will come in contact with such as new aluminum or bronze, shall be wiped with approved solvent, and wiped dry with a clean cloth; to remove any protective coating not tightly adhered and any oil deposit that may be left on the metal surfaces.
- D. All joints shall have a closed-cell polyethylene joint backing, which shall be packed into the joint within 1/2 inch of the surface.
- E. Concrete shall be fully cured, free of release agents, curing compounds, loose aggregate and other surface treatments. Treated surfaces shall be tested for adhesion before proceeding with sealant work.
- F. Joint spaces and surfaces: Thoroughly dry before installation of sealant materials. Do not install sealant materials when temperature is below 40 degrees F, or during or after rain or fog.

3.4 INSTALLATION

- A. The mixing and application of all caulking/sealant compounds shall be in strict accordance with the manufacturer's instructions.
- B. All joints where caulking compounds are to be applied in excess of 1/2 inch in depth shall be packed with a polyethylene foam rod stack filler material to within 1/2 inch from the face to surface. The caulking width and depth in relation to joint movement shall be a maximum of 25 percent compression and 25 percent extension.
- C. Bond breaker strips shall be used where sufficient room for backer rods does not exist or as required by manufacturer.
- D. Primer shall be used as it comes from can, unaltered. Prime joints before insertion of joint filler materials, per caulking/sealant manufacturer's directions.
- E. Seal the heads, sills, and jambs of all windows and the heads and jambs of doorframes where they abut walls.
- F. Sealant shall be applied with full gun pressure forcing the caulking well back into joint. Build the sealant out to a 45-degree angle in all corners, finish the sealant bead by tooling at the doorframes in masonry walls.
- G. Wipe all excess compound and leave in proper condition for painting. Use only a paintable sealant material.
- H. Exterior thresholds shall be set in a full bed of exterior-type sealant compound.
- I. Fill joint with filler material so that depth and width of joint have relationships as noted herein before under "Joint Dimensions".
- J. Sealant materials shall be applied within the "application life" recommended by manufacturer for prevailing temperature and humidity conditions.

- K. Protect exposed surfaces adjacent to joints to prevent permanent staining or other damage to adjacent work.
 - 1. All joints shall be tooled into place to give concave shaped surfaces.
- L. Wood shall be clean, dry and primed with a primer as recommended by the manufacturer of compound to be used.
- M. Metal and glass shall be dry, free of oil, grease and dirt. Immediately before sealing with compounds, wipe surfaces to be filled with clean rags soaked in either methylethyl ketone, high flash naphtha, lacquer solvents, or 50-50 alcohol and water, as appropriate, and wiped dry with a clean cloth.
- N. Seal all interior wood trim and metal surfaces which bear or abut on masonry surfaces and all corners where wood and metal adjoins masonry surfaces. Seal all joints between concrete and masonry surfaces. Masonry joints shall be dry, wire brushed, free of dirt, grease or oil and primed with a primer, recommended by the manufacturer of compound to be used.
- O. If primer used will produce yellowing, discoloration, or dirt pickup when applied on substrates, surfaces adjacent to joint shall be protected from such contamination by use of masking. Care shall be taken to remove masking tape before permanent adhesion takes place.
- P. All exterior wall mounted fixtures shall be caulked at top and both sides of the fixture or mounting plate. All conduits that penetrate exterior wall shall be sealed and junction boxes shall be sealed at the perimeter of the box prior to setting fixture.

3.5 CLEANING

- A. The surfaces of all materials adjacent to caulking and sealing operations shall be cleaned of any smears of compound or other soiling due to the caulking and sealing application. Fresh compound that has been smeared on adjacent surfaces shall be removed immediately and rubbed clean with non-staining solvent.

3.6 MATERIALS AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and replaced with new material in the best workmanlike manner at no extra cost to the Owner.

END OF SECTION 07900

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SECTION 08100 - METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as shown, noted, detailed and reasonably implied on the drawings and in the specifications.

1.3 RELATED 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:
 - 1. Section 04810 – “Unit Masonry Assemblies.”
 - 2. Section 07900 – “Joint Sealers.”
 - 3. Section 08710 – “Door Hardware.”
 - 4. Section 09911 – “Exterior Painting.”
 - 5. Section 09912 – “Interior Painting.”

1.4 SHOP DRAWINGS AND SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300 – Shop Drawings, Product Data and Samples.
- B. Provide a schedule of doors and frames using same reference numbers for openings and details as those on Contract Document. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- C. Show dimensioned door and frame elevations, locations, jamb conditions, methods of assembling, hardware preparation, label compliance, sound ratings, finishes, and anchorage details.
- D. Submit manufacturer's printed literature on all doors frames, louvers and transoms including State of Florida-NOA product approval data sheets, demonstrating performance for all wind load conditions and pressures, outlined per the Structural Drawings. Product Data: For each type of sliding automatic entrance door indicated.

- E. Submit test reports per Article 1.7, this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.
- B. Doors and frames shall be stored per manufacturer's instructions.
- C. All doors shall be individually packaged in cartons completely covering entire door to prevent damage or marring of the finish.
- D. Store doors and frames at building site under cover. Place units on minimum 4 inch high wood blocking. Avoid use of non-vented plastic or canvas coverings which could create humidity chamber. Provide ¼ inch spaces between staked doors to promote air circulation.

1.6 WARRANTY

- A. Hollow metal doors shall be warranted by the manufacturer for a period of one (1) year against delamination, a lifetime warranty on rust perforation, and a one (1) year warranty from defects in materials and workmanship starting from date of substantial completion. See Section 01770 - Closeout Procedures, Detail Requirements.

1.7 TEST REPORTS AND COMPLIANCE

- A. Flush Face Exterior Doors:
 - 1. Acoustical qualities of 1-3/4 inch Doors shall be a minimum sound transmission classification of 26 as tested under ASTM E90. The urethane foam core shall have a "U" factor of 0.067 and "R" factor 14.8
 - 2. Shall meet ANSI A151.1 performance test acceptance criteria for physical endurance; Level "A" (Class A) one million cycles; S.D.I. 100 classification Grade 2, Heavy Duty; Model 4.
- B. Underwriter's Laboratories, Factory Mutual and Warnock Hersey labeled fire doors and frames:
 - 1. ALL labeled fire doors and frames shall be of a type which has been investigated and tested in accordance with UL 10(b), ASTM E152, NFPA 252, ANSI A2.2 and, when required, UL 305.
 - 2. A physical label shall be affixed to the fire door and fire door frame at an authorized facility as evidence of compliance with procedures of the labeling agency.
 - 3. Labeled doors shown on the drawings shall meet the requirements of Underwriter's Laboratories, Inc., for Class of construction and shall bear their approval label, as one of the following.

- a. 3 hour.
 - b. 1-1/2 hour.
 - c. 1 hour.
 - d. 3/4 hour.
 - e. 20 minute.
- C. EXTERIOR OPENINGS: Exterior doors shall comply with wind load criteria specified per the latest version of the FBC. Door material gauges and reinforcement criteria specified here are minimum criteria. Door assemblies shall resist the cyclic pressures, static pressures and missile impact loads as detailed in Florida Building Code test protocols TAS 201, TAS 202, and TAS 203. Subject to compliance with requirements, and complete assembly testing for the Florida Building Code wind load requirements, manufacturers not listed below, offering products that may be incorporated into the work, are subject to the Architect's approval prior to award of the contract.

PART 2 – PRODUCTS

2.1 METAL DOORS (HM-1)

- A. General: Refer to Door Schedule on the Drawings for door profiles.
- B. Metal doors, Type "A" or Class I heavy duty, flush face as manufactured by Baron Metal Industries Inc. Equivalent products manufactured by CECO Corp., Curries, S.W. Fleming Ltd., Steelcraft Manufacturing, Republic Builders Products, Mesker Door, Inc., or Daybar are acceptable.

2.2 CONSTRUCTION

- A. Exterior flush face doors shall be of composite construction, fabricated of two (2) level 2, heavy duty, 18 gauge seamless steel sheets from roller leveled prime quality cold-rolled steel for interior areas and roller leveled prime quality hot dipped galvanized or A60 galvanized steel sheets for exterior areas. Interior doors to be 20 gauge, A60 galvanized with mechanically interlocking seams on door edges only. Gauge of steel sheets may be required to be 16 gauge at exterior doors to resist higher wind pressures and dependent on door manufacturer's standards and the structural capacity of the door dipped galvanized or A60 galvanized steel sheets for exterior areas, with fully welded seams. Interior doors to be 20 gauge, A60 galvanized with mechanically interlocking seams on door edges only.
- B. Doors shall be accurately mortised, reinforced, drilled and tapped for finish hardware. Reinforcement plates for hardware shall be welded to door assembly and be of sufficient size to develop the door strength.
- C. Top and bottom of the doors shall be closed flush by 16 gauge steel channels unless recessed automatic door bottoms are required. See Section 08710 – Finish Hardware.

- D. Minimum gauges for hardware reinforcing plates shall be as follows:
1. Hinges and pivots - 7 gauge W.C.G. steel, prepared for 1 1/2 pairs of standard weight 4" hinges.
 2. Lock face, flush bolts, concealed holders, concealed or surface-mounted closers - 12 gauge.
 3. All other surface-mounted hardware - 16 gauge.
 4. Hardware templates will be furnished by hardware supplier (Refer to Section 08710 – Finish Hardware).
- E. After all welds and joints are ground smooth, the doors shall be thoroughly cleaned, given a coat of baked-on primer, all irregularities filled and made flush and then given a final coat of baked-on primer, interior doors 0.7 mils DFT and exterior doors 1.4 mils DFT. Exterior means doors exposed to outside air atmosphere, or non-conditioned spaces.
- F. Core insulation:
1. Exterior doors shall have rigid urethane or polystyrene core foamed-in-place, or honey combed core, chemically bonded to all interior surfaces of face sheets; core shall be provided per door manufacture's requirements to comply with the FBC windload requirements and thermal ("R" value) requirements at doors that are contiguous to conditioned spaces, as shown on the Drawings or specified, or scheduled.
 2. Interior doors shall have pre-expanded honeycomb core bonded to all interior surfaces of face.
- G. Exterior Doors: Provide weatherstripping (3 sides). In addition, these doors shall include a threshold with recessed channel to receive automatic door bottom when scheduled. Refer to Section 08710 – Finish Hardware.
1. Maximum air infiltration shall be 1.25 cfm per square foot of door area.
 2. Frames shall be prepared to accommodate automatic door bottoms when this hardware is scheduled or required.

2.3 DOORS SWINGING IN PAIRS

- A. Doors shall have two-piece overlapping astragals which consist of an 18 gauge steel edge channel applied to inactive leaf and applied to the active leaf an extruded aluminum overlap strip with wool pile insert. All metal parts painted to match the doors.
- B. Pair of labeled fire doors shall have two-piece overlapping astragals consisting of 16 gauge steel edge channel applied to inactive door and 12 gauge steel overlap strip applied to active leaf in accordance with procedures of labeling agencies.
- C. Refer to Finish Hardware Schedule, Section 08710 – Finish Hardware, for meeting stiles and additional astragals.

2.4 METAL FRAMES

- A. Metal frames shall be of the combination type with the trim and stops formed as an integral part of the frame. Profiles shall be press brake-formed true and sharp with head and jambs accurately mitered, continuously welded and ground smooth (welding type T-3). Frames shall have proper concealed anchors as required for each wall material.
- B. Frames shall be 16 gauge hot-dipped galvanized steel with following anchors as required: Note that metal frames coated with S. W. Fleming Ltd.'s "paintable Galvanneal coating" satisfies the hot-dipped galvanized requirement.
 - 1. Each jamb installed adjacent to masonry shall have one 16 gauge hot-dipped galvanized steel "T" anchor for each 24 inches of the jamb height, 3 min. per jamb.
 - 2. Each jamb installed in existing concrete walls shall use expansion anchors, minimum of 3 per jamb.
 - 3. Each jamb installed in drywall openings shall have a minimum of 3 adjustable drywall stud anchors per jamb.
 - 4. Welded "Z" clips per manufacturers recommendations for specific installation requirements.
 - 5. All door jambs shall rest on building floor slab construction and shall have 12 gauge floor angles welded to jambs for floor anchorage.
 - 6. All door frame assemblies shall have removable steel spreaders welded to the bottom of the jambs to assure alignment.
- C. Frames shall be accurately mortised, reinforced, drilled and tapped for finish hardware. Reinforcing for hardware shall be welded at the frame assembly. Closure bracket reinforcement, plaster guards, hinge reinforcements and reinforcement for all other surface applied hardware to be manufacturer's standard. Dust covers shall be welded over all punched openings and reinforcements to prevent clogging of tapped holes or openings.
- D. After all welds and joints are ground smooth, the doors shall be thoroughly cleaned, given a coat of baked-on primer, all irregularities filled and made flush and then given a final coat of baked-on primer, interior doors 0.7 mils DFT and exterior doors 1.4 mils DFT. Exterior means doors exposed to exterior elements, including but not limited to salt air atmosphere.
- E. Punch lock side of stop for single doors at 3 points and at 2 points on stop at head section of pairs of doors to receive door silencers.
- F. Frames for labeled doors shall meet the requirements of Underwriters Laboratories, Inc., for Class of construction as indicated on schedule, and bear their approved label. See Article 1.7, Test Reports and Compliance.
- G. After fabrication is completed, the frames shall be thoroughly cleaned, bonderized

and given a coat of baked on primer, interior frames 0.7 mils DFT and exterior frames 1.4 mils DFT.

- H. KNOCK-DOWN TYPE FRAMES SHALL NOT BE PERMITTED!
- I. Prepare frames to receive hardware as specified in Section 08710 – Finish Hardware.

2.5 LOUVERS AND FRAMES

- A. Door louvers, where scheduled or shown shall be of the fixed slat type providing a minimum of 50% net free area. Louver blades shall be formed of 18 gauge steel and set in 16 gauge frames. Louvers for exterior openings shall have insect screens set in removable frames, mounted to the inside face of louver.
- B. Panels above doors shall be of the same construction as door below panel.

2.6 PAINTING

- A. Painting of hollow metal doors and frames shall comply with the following:
 - 1. Door and Frame Schedules.
 - 2. Section 09911 – Exterior Painting.
 - 3. Section 09912 – Interior Painting.
 - 4. Field apply bituminous paint to first 18 inches above finish floor of all exterior hollow metal door frames at interior/concealed surfaces of the door frame.
- B. Colors of doors and frames shall be approved and selected by the Architect and Owner.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. All work shall be shop fabricated by experienced, qualified mechanics of this trade, to required profiles by forming and welding with corners, angles and edges straight and sharp.
- B. Fit and fabricate accurately with corners, joints, seams and surfaces free from warp, wave buckle or other defects.

3.2 INSTALLATION

- A. All metal doors and frame shall be installed true, level and plumb and in the best workmanlike manner of this trade. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
- B. All door hardware shall be installed in strict accordance with the manufacturer's printed instructions and free of all defects.

- C. At masonry walls, frames shall be braced until wall in which frame is installed is complete.
- D. Frames to be installed in masonry walls shall be set prior to starting masonry work. Anchors shall be installed in jambs and in masonry joints, the area between the masonry and jamb shall be filled solid with mortar. Frame installation shall comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", and as specified herein.
- E. Templates for all hardware items shall be coordinated with hardware suppliers.
- F. Install fire rated frames according to NFPA 80 and fire rated doors with clearances specified in NFPA 80. Fit doors accurately in frames, within clearances specified in ANSI/SDI-100.
- G. Provide a minimum of three anchors per jamb, adjacent to the hinge location on the hinge jamb, and at corresponding heights on strike jamb.
- H. Prime coat touch up immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up coating of compatible air drying primer.

3.3 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at no extra cost to the Owner.
- B. Check and re-adjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08100

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SECTION 08120 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
- C. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Provide samples for each color, texture, and pattern of plastic laminate required.
 - c. Finish veneer-faced door samples with same materials proposed for factory-finished doors.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Quality Standard: NWWDA 1.S. 1-A, AWI Section 1300, WIC. B. Fire-Rated Wood Door Standard: NFPA 80.
 - 1. Oversize Fire Rated Wood Doors: For Doors exceeding sizes of tested doors, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with construction requirements for tested and labeled fire rated doors except for size.
- D. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Marshfield Door Systems, Inc.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Certified Wood: Fabricate doors with not less than 70 percent of wood products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- C. WDMA I.S.1-A Performance Grade:
 - 1. Standard Duty unless otherwise indicated.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: AWI Grade A Custom
 - 2. Faces:
 - a. Rotary natural birch-white

3. Species: White Birch
4. Cut: Rotary Cut
5. Match between Veneer Leaves: Book Match
6. Match within Door Faces: Center Balance Match
7. Assembly of Veneer Leaves on Door Faces: Running match
8. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
9. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
10. Core: Particleboard which complies with ANSI A208.1-LD-2
11. Construction: PC5 equal to Marshfield DPC-1
12. Bonding: Stiles and rails bonded to core
13. Stiles: to be matching/compatible to face veneer
14. Fire-rated solid-core doors
 - a. Faces and Grade: Provide faces and grade to match non-fire-rated doors in same area of building, unless otherwise noted
 - b. Construction: Manufacturers standard core construction required to provide specific fire resistance rating and complying with applicable requirements of referenced quality standards. Doors to be equal to Marshfield DFM series.
 - c. Stiles: To be matching/compatible to face veneer.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 1. Fabricate door and transom panels with full-width, solid-lumber[, rabbeted,] meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Transparent Finish:
 - 1. Grade: Custom.
 - 2. Quality Standard: AWI Section 1500.
 - 3. Type: Finish must meet or exceed performance standards of AWI TR-6 catalyzed polyurethane.
 - 4. Staining: To be selected from manufacturers standard stain colors.
 - 5. Grain Effect: Open.
 - 6. Sheen: Semi-gloss.
 - 7. Sealing of top and bottom edges: Edges must be factory sealed unless door manufacturer specifically states in writing that full lifetime warranty will cover doors without sealed end rails.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 08710 "Door Hardware".
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Access doors and frames for walls and ceilings.

- a. Provide access doors as required in walls and gypsum wall board ceilings for access to equipment and operational controls, where removal for access of ceilings are not scheduled or shown on the Drawings.

- B. Related Requirements:

- 1. Division 15 Section "Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, fire ratings, materials, individual components and profiles and finishes.

- B. Shop Drawings

- 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.

- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

1. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Basis-of-Design Product:

1. Karp Associates, Inc.
2. Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - a. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - b. Larsen's Manufacturing Company.
 - c. Milcor Inc.

- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- E. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

- F. Aluminum Sheet: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2.
- G. Frame Anchors: Same type as door face.
- H. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness. Paint to match adjacent surface in public areas.
- C. Access Panel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 - 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.5 FINISHES

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

D. Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Field paint to match adjacent surface or color selected by Architect if adjoining finish is not painted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

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

END OF SECTION 08311

SECTION 08330 – OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 A. Overhead coiling doors.

1.3 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Support framing and framed opening.
- B. Section 09900 - Painting: Field applied finish.
- C. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Conduit from electric circuit to door operator and from door operator to control station.
- D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Power to disconnect.

1.4 REFERENCES

- A. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
- B. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
- C. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- D. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- F. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- G. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. NEMA MG 1 - Motors and Generators.

1.5 DESIGN / PERFORMANCE REQUIREMENTS

A. Overhead coiling insulated doors:

1. Wind Loads: Design door assembly to withstand wind/suction load per the wind load drawings or as required by FBC without damage to door or assembly components in conformance with ASTM E 330.
2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

B. Single-Source Responsibility: Provide doors, tracks, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

D. Windborne – Debris Impact Resistance: Provide overhead coiling doors that pass missile-impact (large-missile test) and cyclic-pressure tests according to ASTM E 1996 for the wind zone for the building location, the requirements per FBC or as noted and scheduled.

1.6 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Details of construction and fabrication.
4. Installation instructions.
5. FBC NOA product approval.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction. Include rated capacities, operating-characteristics, electrical characteristics, and furnish accessories for electrically powered doors.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years' experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- D. Closeout Submittals – Maintenance and warranty data.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weather tight location.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.11 WARRANTY

- A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
- B. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com, or architect approved equal.
- B. Subject to the compliance of the specified requirements a comparable product by one of the following manufacturers will be considered.
 - a. Clopay.
 - b. Cookson Company.
 - c. Cornell Iron Works, Inc.
 - d. Raynor.
 - e. Wayne-Dalton Corp.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 INSULATED OVERHEAD COILING SERVICE DOORS

- A. Overhead Coiling Service Doors: Overhead Door Corporation Model 625.
 - 1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
 - b. Front slat fabricated of:
 - 1) 18 gauge galvanized steel.
 - c. Back slat fabricated to match front slat:
 - 1)
 - d. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.
 - 1) R-Value: 7.7, U-Value: 0.13.
 - 2) Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame spread and smoke developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within slat faces.
 - 2. Performance:
 - a. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
 - b. Wind load resistance as specified, shown on the drawings or required by FBC.

3. Finish:
 - a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
 - 1) Powder coat: PowderGuard
 - (a) PowderGuard Weathered Finish: Industrial textured powder coat provides a thicker, more scratch resistant coat. Applied to entire door system including slats, guides, bottom bar and head plate color as selected by the Architect.
 - 2) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
4. Weatherseals:
 - a. Vinyl bottom seal, exterior guide and internal hood seals.
 - b. Interior guide weatherseal.
 - c. Lintel weatherseal.
5. Bottom Bar:
 - a. Two galvanized steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
6. Guides: Three Structural steel angles
 - a. Finish: PowderGuard Weathered finish with iron/black powder.
7. Brackets:
 - a. Galvanized steel to support counterbalance, curtain and hood.
 - b.
8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
9. Hood: Provide with internal hood baffle weatherseal.
 - a. 24 gauge galvanized steel with intermediate supports as required.
10. Manual Operation:
 - a. Chain hoist; endless steel hand chain, chain-pocket wheel and guard and gear-reduction unit with maximum 25 lbf force for door operation (reversible).
11. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction; provide alley-steel hand chain holder secured to operator guide at not less than 2/3 foot nor more than 1 foot per second; with controller (disconnect switch) for motor exposure indicated.
 - a. Sensing Edge Protection:
 - 1) Pneumatic sensing edge.
 - 2) Electric sensing edge.
 - b. Operator Controls:
 - 1) Push-button operated control stations with open, close, and stop buttons at interior.
 - 2) Key operation with open, close, and stop controls.
 - 3) Push-button and key operated control stations with open, close, and stop buttons at exterior.
 - 4) Controls surface mounted at interior.
 - 5) Controls flush mounted at exterior.

- c. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
- d. Operator Location: Top or Front of hood for easy removal and access.
- e. Motor Exposure: Humid; interior.
- f. Comply with NFPA 70.
- g. Single phase 208 volts, Hertz 60
- h. Special Operation:
 - 1) Vehicle detector operation.
 - 2) Radio control operation.
 - 3) Card reader control.
 - 4) Photocell operation.
 - 5) Door timer operation.
 - 6) Commercial light package.
 - 7) Explosion and dust ignition proof control wiring.
- i. Motor Voltage: 115/230 single phase, 60 Hz.
- 12. Windload Design:
 - a. FBC certification FL# to meet wind loading specified or shown on the drawings, and per FBC requirements.
- 13. Locking:
 - a. Chain keeper locks for chain hoist operation.
 - b. Interior slide bolt lock for electric operation with interlock switch.
 - c. Cylinder lock, exterior only.
 - 1) cylinders specified in for electric operation with interlock
 - 2) Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power when door is locked.
- 14. Wall Mounting Condition:
 - a. Between jambs mounting.
- 15. Insulated: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame spread and smoke developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within slat faces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Coordinate and install the wiring and electrical requirements for motors and other electrical devices with building electrical system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.
- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.
- C. Lubricate bearings and sliding parts as recommended by manufacturer.
- D. Adjust seals to provide a tight fit around entire perimeter.

3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.

- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION 08330

SECTION 08342 – MOTOR OPERATED HANGAR DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes individually motor operated hangar doors and defines the nature and quality of required doors and their minimum standards of construction and operation.
- B. Related Sections include the following:
 - 1. Division 3 Section "Concrete" for concrete foundations, bottom rails, cross ties and anchor-bolt installation.
 - 2. Division 9 Section "Painting" for finish coats, touch-up of shop primer coat, field welds and field bolts.
 - 3. Division 8 Section "Steel Doors and Frames" for personnel doors and frames supplied by others to be installed in hangar doors.
 - 4. Division 13 Section "Metal Building Systems" for metal siding panels, metal liner panels, jamb and corner trim, siding accessories, top guide supporting steel and bracing.
 - 5. Division 26 Sections for field wiring, conductors, conduit, boxes, exit lights and installation of trolley duct system.

1.3 DEFINITIONS

- A. General: Hangar doors for clear opening approximately 85'-0" wide by 25'-0" high and consisting of a six (4) leaf motor operated bi-parting door system installed on four (4) bottom rails. Each door system to be complete with bottom wheels, top guide rollers, operators, brakes, controls, hardware, weathering, top guides, bottom rails, trolley ducts, etc.
 - 1. 1 sets of doors for maintenance hangar

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: The 4-leaf bi-parting door system shall be designed so each door shall be supported on its own bottom wheels and guided with its own top rollers. The drive leaf of each group shall be powered by a traction drive motor operator and the idler leaves shall be interconnected to the drive leaf by a mechanical plate interconnection system.

1.5 Door System Design:

1. The idler leaves of each door group shall be controlled by the movement of the drive leaf as induced by the pickup plate system. The doors shall require operating personnel to walk alongside of the door as it moves.
2. Furnish for other trades all drawings and details for any structural steel, bracing, holes required and the like that will be part of building construction performed under other Divisions of the specifications, but which will be required for proper installation of the doors. Drilling of holes, cutting or any other work affecting the structural framing of the building shall be subject to approval of the Engineer.
3. **Furnish all supervision, labor, materials, tools, equipment and services required for fabrication and erection** of the motor operated hangar doors in strict accordance with the specifications and applicable drawings.
4. Without restricting the generality of the foregoing, the following shall be included:
 - a. ASTM A-36 structural steel framing and bracing for door leaves.
 - b. Full depth horizontal girding to accommodate the exterior preformed metal building siding and the interior preformed metal liner panel, full height of the doors.
 - c. Bottom wheels, axles and tapered roller bearings.
 - d. Telescoping straddle type top guide roller assemblies.
 - e. Complete weather-stripping; including floating head wind curtain weathering.
 - f. All required hardware for motor and manual operation; top bumpers, tow eyes and rail wipers.
 - g. One complete motor operator system in each door group.
 - h. One complete set of electrical controls; push buttons, limit switches, etc in each door group.
 - i. Complete trolley duct electrification system and supports.
 - j. Top guides, closure plate, trolley duct supports and stops; continuous from door jamb to door jamb.
 - k. **ASCE 30#/yd bottom rails**, cross ties and anchor bolts.
 - l. One coat of primer paint on all fabricated structural steel, and painted factory finished on all pre-assembled components.
 - m. Complete engineering drawings, calculations and required submittals sealed by the manufacturer's registered professional engineer.
 - n. **Door erection/installation.**
 - o. Maintenance and operating manuals.
 - p. **Guarantee of complete installation.**

5. Design criteria: Door leaves shall be designed and constructed in accordance with the latest American Institute of Steel Construction Specifications. They shall consist of standard structural sections of ample size and strength for the loads and stresses imposed under the specified conditions. Structural shapes and flat plates shall be in accordance with ASTM Designation A-36.
 - a. Door leaves as completed units shall be designed to withstand the minimum external and/or internal wind load of **115 mph, Exposure C, Risk Category II** as indicated on Structural drawing sheet S0.0, under the Main Wind-force Resistant system provisions of the current edition of the 2012 International Building Code (IBC) and per ASCE 7-98.
 - b. The wind load deflection shall not exceed the door height in inches divided by 120.
 - c. The fiber stresses in the door members due to combine dead and wind loads shall not exceed 24,000 psi.

1.6 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following hangar door system components:

6. Structural-framing system.
7. Electrical control system.
8. Electrical trolley system.
9. Door motor units.
10. Accessories.

B. Shop Drawings: For the following hangar door system components. Include plans, elevations, sections, details, and attachments to other Work.

1. The door manufacturer shall submit for approval all design and shop drawings and complete calculations of all structural, mechanical, electrical and operational features of the doors, operators and brakes sealed by registered professional engineer licensed to practice in the project location. Field wiring diagrams, schematic wiring diagrams and physical location of electrical controls drawings shall be provided. The shop drawings shall name and list in detail the components used in and on the doors, including the manufacturer's name, catalog number and a full description of the component.
2. Complete calculations shall be submitted with the shop drawings proving that the coefficient of adhesion between the steel rails and the steel wheels is in fact 0.25. Shop drawings submitted without these calculations will be returned marked "Revise and Resubmit".

- C. Product Certificates: Signed by manufacturers of hangar door systems certifying that products furnished comply with requirements.
 - 1. Letter of Design Certification: Professional engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where Project is located, verify that the structural framing meet indicated loading and deflection requirements and codes of authorities having jurisdiction. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Door dimensions, including width and height.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, deflection, wind loads/speeds and exposure, seismic zone or effective peak velocity-related acceleration/peak acceleration.
- D. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements. Include evidence of manufacturing experience.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Warranties: Special warranties specified in this Section.

1.7 QUALITY CONTROL

- G. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- H. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangar door systems that are similar to those indicated for this Project in material, design, and extent.
- I. Manufacturer Qualifications: A firm experienced in manufacturing hangar door systems similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Doors and operating mechanisms shall be manufactured by a door manufacturer who has been continuously engaged in the design, manufacture, and installation of large aircraft hangar doors for over twenty five (25) year minimums. The

manufacturer will support with written evidence that they have designed, manufactured and installed a minimum of thirty (30) motor operated door systems which have been in satisfactory operation for a minimum of three (3) years, with a minimum of ten (10) installations that are equal to or in excess of 28'-0" high.

2. Written evidence will include at least thirty (30) hangar door installations of the bi-porting motor operated type, made by their company. Such list shall include name of installation, location, owner, architect, date installed and specific data as to size of doors, type of operators, brake systems, safety devices, operating systems, top guide rollers, weather-stripping, etc. Written evidence shall list only door installations that have been designed, manufactured and installed by the submitting door manufacturer. The door manufacturer must certify that they will design and fabricate 90 percent or more of the door system by their personnel and in their facilities.
 3. Engineering Responsibility: Preparation of Shop Drawings, testing program development, test result interpretation, and comprehensive engineering analysis by a qualified professional engineer.
- J. Source Limitations: Obtain each type of the hangar door system component through one source from a single manufacturer.
- K. Structural Steel: Comply with AISC S335, "Specification for Structural Steel Buildings-- Allowable Stress Design, Plastic Design"; or AISC S342, "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.

1.8 DELIVERY, STORAGE, AND HANDLING

- L. Deliver components, panels, and other manufactured items so as not to be damaged or deformed. Package items as required for protection during transportation and handling.
- M. Handling: Unload, store on timbers or pallets above ground level to prevent bending, warping, twisting, and surface damage.
- N. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Do not store material in contact with other materials that might cause staining, denting, or other surface damage.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify door opening by field measurements after the metal building has been erected and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions for Doors: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabrication of the door leaves without field measurements. Coordinate the door opening construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.6 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Warranty Period: **Two years** from date of Substantial Completion.
2. Four (4) complete three ring binders containing instructions for proper operation and maintenance of the doors shall be furnished to the Owner. They shall contain complete:
 - a. Operating instructions.
 - b. Maintenance instructions.
 - c. A chart showing all points to be lubricated, type of lubricant and frequency of lubrication.
 - d. A chart giving a checklist of parts to be serviced and adjusted and the frequency of adjustment.
 - e. A complete list of spare parts.
 - f. A manufacturer's catalog for each and every component used in or on the doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. **Aero Door, a division of the J. B. Matthews Company**
2. Door Engineering and Manufacturing Co.
3. D.P. Industries
4. Fleming Steel Company
5. International Door, Inc.
6. Industrial Door Contractors Inc.
7. Norco Industrial Doors

2.2 STRUCTURAL MATERIALS

- A. Structural-Steel Shapes: ASTM A 36.

- B. Steel Plate, Bar, or Strip: ASTM A 36
- C. Steel Tubing or Pipe: ASTM A 500, Grade B; ASTM A 501; or ASTM A 53, Grade B.
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.
Direct-Tension Indicators: ASTM F 959, Type 325 or Type 490
 - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50, epoxy coated.
- E. Primers: As selected by manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, capability to provide a sound foundation for field-applied topcoats despite prolonged exposure, and as follows:
 - 1. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer; complying with performance requirements of FS TT-P-664.

2.3 FABRICATION, GENERAL

- A. Door Leaf Construction: Door members in sizes suitable for convenient shipping shall be bolted and/or welded construction. Joints shall develop 100 percent of the strength of the framing members. Vertical members shall be continuous throughout the height of the door. The sections and framing members of which they are composed shall be true to dimension and square in all directions and shall not be out of line more than 1/8 inch in 20 feet. Vertical and horizontal members adjacent to each other and/or being joined together in the field shall be accurately prepared to facilitate field assembly. Full depth members spaced vertically shall be provided for proper lateral support of inside and outside flanges for all main members. Diagonal bracing shall be provided so that the completed leaf assembly will be adequately braced to withstand shipping, assembly and operational loads.
 - 1. Fabrication of door sections shall be done in jigs so as to hold the sections to specified tolerances. Exposed welds and welds, which interfere with the installation of various parts, such as exterior panels and liner panels, etc., shall be ground smooth.
 - 2. The exterior and interior door covering shall be preformed metal panels of the type and gauge, furnished and installed as specified in Division 13 "Metal Building Systems".
- B. Weathering: Material, which is adjustable and readily replaceable, shall be provided at all necessary vertical edges, heads and sills to afford a substantially weather-tight installation.
 - 1. Material on jambs and sill shall be flap 2-ply cloth-inserted 100% EPDM 1/8 inch thick. Weathering shall be retained continuously by steel keeper bars for its full length and secured with rust resistant fasteners on twelve (12) inch centers.

2. Vertical weather-stripping at the jambs (lap Condition) and the interface between the door leaves shall close against metal flashing that are cold formed to the configuration and located on the door leaves and jambs as shown on the drawing by the metal building manufacturer. They shall be attached to the door leaves and jambs on twelve (12) inch centers with standard siding fasteners.
 3. Head weathering shall consist of two parts. The floating head wind curtain weather-stripping flashing, which is attached to the top guide rollers, shall consist of support angles which move up and down with the telescoping type top roller to accommodate the live load roof movement and the sixteen (16) gauge curtain attached to the angles across the exterior face of the door and returning around the leading edge of the door lead. The flexible weathering part attached to the top of the door leaves shall be 1/8 inch 2-ply cloth inserted EPDM to mate with the floating head weathering portion. It shall be attached at twelve (12) inch center with 1/4 inch plated hex fasteners.
 4. Where hangar door leaves butt each other in the full closed position, the abutting door edges shall have one compression bulb weathering. Bulb weathering shall be full height of the door and shall be composed EPDM mounted on a structural angle and retained with continuous bars 1-1/2" x 3/16" and rust resistant hex head self-tapping screws at not over twelve (12) inch centers.
 5. Weathering shall be properly fitted and adjusted to close all openings. It shall be fitted at the factory, marked and removed before shipment. Clearances between metal parts on vertical edges of leaves and between leaves and jambs, which are to be weathered, shall no be less than three (3) inches.
- C. Hardware: Hardware shall be designed and manufactured expressly for use on **aircraft hangar doors**. The door manufacturer shall provide top guide roller assemblies, bottom wheels, bumpers, tractor pulls and track cleaners as part of the finished door.
1. Top Guide Rollers: Each door leaf section shall be provided with two top guide roller assemblies. They shall be of the telescopic straddle type with vertical and horizontal rollers. Rollers shall be made of steel and shall be at least 3/4" thick for satisfactory performance under the designated load conditions.
 - a. Rollers shall be provided with graphite bronze bearings and shall be mounted on steel pins. Top guide rollers, in coordination with the W6x9 guide beams, shall accommodate a maximum total live load roof movement of six (6) inches uplift plus 9 inches down deflection.
 - b. The door manufacturer shall furnish and install to the top guide tracks, closure plate and door stops. The top guides shall be installed on the structural supporting steel (maximum 10'-0" centers) that has been furnished and installed by others. This supporting steel shall be fabricated and installed in accordance with the approved door manufacturer's drawings.
 2. Bottom Rollers: Bottom rollers shall be made of plate steel having a minimum tread diameter of **fifteen (15)** inches. They shall be a high steel meeting or exceeding the minimum ASTM designation A-36 requirements for plate wheels. Rollers shall be designed to permit removal without taking the door leaves from their position on the rails.

- a. Treads shall be machined concentric with bearing seats. The horizontal clearance between wheel and rail shall not be more than 1/8" at the bottom nor more than 1/4" at the edge of the flange.
 - b. Two internally or externally mounted tapered roller bearings shall be provided for each wheel. Bearings shall be arranged so that both the vertical loads from the leaves and the horizontal wind loads can only be transmitted from the leaf to the wheel through the bearings. Bearings shall be provided with seals to retain the grease and prevent the entrance of dirt and shall be equipped with approved type of high-pressure grease fittings.
 - c. Bottom rails shall be ASCE **30 #/yd**. The section joints shall be fastened by standard rail splice bars. Cross ties shall be provided at 4'-0 centers. Anchor bolts shall be 5/8 inch diameter, double nutted. This material shall be furnished by the door manufacturer and installed by others in strict accordance with the door manufacturers approved drawings.
3. The hangar doors shall not be equipped with locking devices, except as specified for personnel doors.
 4. Rubber bumpers shall be provided on the leading and trailing edges of each leaf at top and bottom as required to prevent individual leaves from coming in contact with the end walls or any other obstruction.
 5. Substantial and adequate tractor pull brackets shall be provided on the leading and trailing edges of each drive leaf so that each group can be towed by a tractor or other suitable equipment in the event of power failure can tow the leaves.
 6. Suitable track cleaners shall be provided at leading and trailing edges of door leaves to wipe clear the rail head and the wheel flange grooves as the leaves move.
 7. Pick up plates system that interconnects the door leaves together shall be a structural plate and channel system. The pickups shall be mounted on the trailing edge and leading edges of the door leaves as required and at a full depth member connection. They shall be sized to take the full impact load as induced when connecting the adjacent leaf under full velocity of the door system.
- D. Shop Paint: Door framing members shall be thoroughly cleaned of loose scale, shavings, filings, dirt, dust or other objectionable materials that would interfere with the bond of paint.
1. All shop painting shall be done in accordance with good practice for such work. No painting shall be done in freezing weather. All painting shall be done in dry weather or under cover and surfaces of steel shall be free from moisture when painted.
 2. All metal surfaces shall be given a priming coat of rust inhibitive paint.
 3. Special care shall be taken in painting mechanisms, limit switches, electrical controls, etc., so that paint is applied to finished or to bearing surfaces. Components supplied by other manufacturers having painted surfaces need not be painted.
- E. Operating System: Operation of each door shall be by traction type power drives with one in each drive leaf. Operating and drive system must be UL 508A approved. The power drives shall be designed to move the leaves in either direction, at a maximum speed of 45 feet per minute at zero wind load conditions and shall be operable up to and including a wind load of 8 pounds per square foot.

1. The power drive units shall consist of a gearhead motor with high-speed shaft brake coupled to separate gear reducer. The necessary roller chains, sprockets, take-up devices necessary to drive the leaves shall be provided.
 2. Each system shall be provided with an acceptable means of emergency conversion to tractor towing.
 3. The drive motors shall be squirrel cage induction type, 1.5 HP and sized to operate the leaves under zero wind load conditions at not more than 75% of their rated capacity; motors shall be rated for door operation duty and shall be normal starting torque type. They shall be wound for service at 480 volt, single or 3 phase, 60 hertz OR 277 volt, single phase, 60 hertz.
 4. The gear reduction units shall be of the highest quality helical worm gear double reduction of commercial manufacture and shall have internal continuous lubrication. The units shall be of a type which allows a reversal of effort through the gears without damage to the gears. The gears shall be nonself-locking and be rated AGMA standard with a safety factor of 1.
 5. The high speed shaft brakes shall be integral with the motors and shall be the spring set solenoid release self-adjusting disc type with an auxiliary auto-resetting manual release.
 6. Readily removable covers located on the inside of the leaves shall provide access to the drive units, roller chains, sprockets, etc.
 7. Concrete ballast shall be added to the powered leaf in each group of doors, as required, to obtain a coefficient of adhesion of 0.25. Space for the concrete shall be provided by the door manufacturer. **Ballast shall be provided by the General Contractor.**
- F. Electrical Controls: The door manufacturer shall furnish the doors with the proper electrical equipment and controls, built in accordance with the latest NEMA Standards. All equipment, power and control circuits shall be installed in accordance with the National Electrical Code, Standard No. 70, and the requirements of authority having jurisdiction. Control system must be UL 508A approved. Any equipment located eighteen (18) inches or less above the floor shall be explosion proof.
1. Magnetic reversing starters shall be enclosed in a NEMA 12 enclosure with a three pole fused lockable disconnect in the cabinet door and shall be factory wired and equipped with overload and undervoltage protection, mechanical and electrical interlocks, relays, timing devices and transformers for the control circuits. A wiring diagram shall be placed on the inside of each enclosure cover.
 2. Each drive leaf shall be controlled by a constant pressure 2-button push button station, mounted on accessible interior faces at each end as required for a safe operable condition. Removing pressure from the buttons shall stop the motor drive units and set the brakes. The buttons at the end of the leaves shall allow it to travel with the adjacent edge as the leading edge only. Controls shall not be reversible. All interior push buttons shall be in NEMA 12 enclosures with mushroom head buttons. All exterior push buttons shall be in NEMA 4 enclosures with mushroom head buttons.
 3. Limit switches shall be provided to stop the travel of the doors in their fully opened or fully closed positions. The limit switches shall be positive acting snap action type with actuating cams designed with sufficient overtravel to permit the group to come to a complete stop without over traveling the limit switches. The limit switches shall be mounted on the power leaf with actuating cams mounted on the top guides overhead.

4. Hollow metal personnel door interlocks shall be provided. Interlock shall prevent motor operation of the hangar door group when the personnel door is open. Provide an indicator light at door control stations indicating when the personnel door is open.
 5. Warning Buzzer/Strobe Light Signal Column: Pulsating audible/visual signal column installed on the powered leaf of hangar door system. Audible volume of warning buzzer shall not be less than 45db. The warning device shall automatically signal movement of the powered leaf and shall sound pulsate continuously while door is being operated.
 6. The signal shall sound continuously when the door group is in motion.
 7. Each control enclosure shall be completely shop wired and be provided with a numbered terminal strip for the convenience of the electrical contractor.
- G. Trolley Ducts: One full length run of trolley duct shall be provided for the bi-parting door system. Ducts shall be U-S Safety Trolley or equal with four (4) solid copper conductors in a protective PVC housing. They shall be located as shown on the shop drawings. They shall be rated for one hundred (100) amperes continuous duty.
1. Each run shall consist of the required number of sections of straight track, feed boxes, end caps, couplings, hangers and other accessories to make the system complete and workable.
 2. One top roller supported trolley and trolley pull bracket shall be supplied for each powered door group complete with brush contacts.
 3. The door manufacturer shall supply all components for the trolley duct system. All wiring material and labor to install and connect the trolley ducts shall be accomplished by the electrical contractor.
- H. Electrical Wiring and Source of Power: All trolley ducts, conduit and fittings, flexible multi-conductor cables, junction boxes, and all labor to wire and connect to and between all electrical equipment on the doors shall be installed in accordance with the door manufacturer's approved wiring diagrams and drawings by the electrical contractor.
1. If permanent electrical power is not available when the doors are installed, the electrical contractor shall obtain a temporary source of electrical power so the doors may be tested and adjusted under power.
 2. The door manufacturer's wiring diagrams shall include a complete schematic wiring diagram; a field wiring diagram; a complete physical location drawing showing the location of all controls with the runs of conduit, size of conduit, number and size of wires in each conduit, location of junction boxes and full details of control mountings.

2.4 WALL PANELS

- A. Panels (interior and exterior faces of each door leaf) to be provided by the General Contractor as part of the Metal Building package. Refer to Division 13 Section "Metal Building Systems" for metal siding panels, metal liner panels, jamb and corner trim, siding accessories, wall insulation, top guide supporting steel and bracing requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the hangar door system.
 - 1. For the record, prepare written report, listing conditions detrimental to performance of work.
 - 2. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Erect metal building system according to manufacturer's written instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from the hangar door manufacturer's professional engineer.
- C. Hangar doors shall be erected when the hangar roof has been completed and is in its proper position under full dead load. When the hangar roof is completed and in position, the door guides shall be adjusted in relationship to the rails to the proper line, gauge and elevation in accordance with the approved tolerances stated herein.
- D. All hangar doors and accessories shall be assembled in strict accordance with the approved shop and erection drawings. **The doors shall be installed under the supervision of an authorized representative of the door manufacturer**, who shall be responsible for proper and satisfactory operation.
- E. Align and adjust framing members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Make adjustments to compensate for discrepancies in alignment.

3.3 WALL PANEL INSTALLATION

- A. General: Provide panels full height as shown on building elevations, sections and details. Install panels perpendicular to girts.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Install panels with vertical edges plumb. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 2. Unless otherwise indicated, begin panel installation at corners with center of rib lined up with line of framing.
 - 3. Field cutting by torch is not permitted.
 - 4. Align bottom of wall panels and fasten with blind rivets, bolts, or self-tapping screws.
 - 5. Fasten trim and similar elements with self-tapping screws.

6. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 7. Provide weather-resistant escutcheons for items penetrating wall panels and liner panels.
 8. Use aluminum or stainless-steel fasteners for exterior applications and galvanized fasteners for interior applications.
 9. Locate and space fastenings in true vertical and horizontal alignment.
- B. Field-Assembled Panels: Install wall panels on the exterior side of doors. Attach panels to supports with fasteners as recommended by manufacturer. Install insulation and cover with liner panels.
- C. Liner Panels: Install panels on interior side of doors. Fasten with exposed fasteners as recommended by manufacturer.

3.4 INSPECTION AND TESTING

- A. Inspection of the hangar door installation will be made after erection is complete. Any defects disclosed by the test shall be corrected by the door manufacturer and the installation delivered in and acceptable operable condition.

3.5 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean, prepare, and prime or reprime welds, bolted connections, and abraded surfaces of prime-painted framing, accessories, and plates.
1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 2. Apply compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 083420

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SECTION 08360 – SECTIONAL HIGH-LIFT DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulated Sectional Overhead Doors.

1.2 RELATED SECTIONS

- A. Section 05500 - Metal Fabrications: Steel frame and supports.
- B. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.
- C. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.
- D. Section 08710 - Door Hardware: Cylinder locks.
- E. Section 09900 - Paints and Coatings: Field painting.
- F. Section 16130 - Raceway and Boxes: Empty conduit from control station to door operator.
- G. Section 16150 - Wiring Connections: Electrical service to door operator.

1.3 REFERENCES

- A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Wiring Connections: Requirements for electrical characteristics.
 - 1. Coordinate with Electrical Drawings.
- B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.
- 1.8 PROJECT CONDITIONS
- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- 1.9 WARRANTY
- A. Warranty: Manufacturer's limited door and operators System warranty for 10 years against delamination of polystyrene foam from steel face and all other components for 1 year and covered under General Conditions of Contract.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: arcat@overheaddoor.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 INSULATED SECTIONAL OVERHEAD DOORS

- A. Insulated Steel Sectional Overhead Doors: 470 Series Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
 - 1. Door Assembly: Rigid steel construction; fully insulated on the inside face with continuous steel backing on the inside face. Fabricated with steel end stiles and tongue and groove sections.
 - a. Panel Thickness: 2 inches (51 mm).
 - b. Exterior Surface: Ribbed.
 - c. Exterior Steel: 26 gauge, hot-dipped galvanized with an embossed simulated wood grain texture.
 - d. Interior Steel: 29 gauge, hot-dipped galvanized
 - e. Springs:
 - 1) 50,000 cycles.
 - f. Insulation: Polystyrene.
 - g. Thermal Values:
 - 1) Polystyrene - R-value of 9.83; U-value of 0.102.
 - 2. Finish and Color: Two coat baked-on polyester. Color as follows:
 - a. As selected by Architect and Owner from Manufacture standard color selections.
 - 3. Windload Design: Provide to meet the Design/Performance requirements specified.
 - 4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
 - 5. Lock:
 - a. Interior mounted slide lock with interlock switch for automatic operator.
 - 6. Weatherstripping:
 - a. Flexible bulb-type strip at bottom section.
 - b. Flexible Jamb seals.
 - c. Flexible Header seal.
 - 7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
 - 8. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
 - a. Entrapment Protection: Required for momentary contact, includes radio control operation.
 - 1) Photoelectric sensors monitored to meet UL 325/2010.
 - b. Operator Controls:

- 1) Push-button and key operated control stations with open, close, and stop buttons.
- 2) Surface mounting.
- 3) Interior location.
- c. Special Operation:
 - 1) Pull switch.
 - 2) Radio control operation.
 - 3) Door timer operation.
 - 4) Commercial light package.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until openings have been properly prepared.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.
- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean adjacent surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- C. Anchor assembly to wall construction and building framing without distortion or stress.
- D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- E. Fit and align door assembly including hardware.
- F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 CLEANING AND ADJUSTING

- A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
- B. Clean doors, frames, glass and polycarbonate according to manufacturer's instructions.
- C. Remove temporary labels and visible markings. Do not remove polycarbonate care and maintenance label required to maintain warranty.

3.5 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.
- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION 08360

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SECTION 08710 – DOOR HARDWARE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work covered by this Section of Specifications consists of furnishing and delivering to the jobsite for fitting and installation, all Finish Hardware complete, in accordance with this Section, applicable drawings, and contractor's shop drawings, and subject to the terms and conditions of the Contract. It is intended that the following list of hardware will cover all Finish Hardware to complete the project. Omissions and/or discrepancies shall be brought to the Architect's attention during the bidding period. **THE HARDWARE PROVIDED WILL NEED TO MATCH THE AIRPORT'S "CAMPUS" STANDARD, AND SHALL BE CONFIRMED BY THE CONTRACTOR PRIOR TO ORDERING MATERIAL.** The electronic locks and panic devices will need to be compatible with the Airport's security system.
- B. The Contractor shall employ a DHI-certified Architectural Hardware Consultant who shall review the enclosed schedule and provide a detailed hardware submittal based on the Drawings and Specification requirements, and provisions for operation of the doors for this Project.
- C. Furnish and install construction temporary hardware as required by the Contractor to secure finished units until accepted by the Owner.
- D. Fire-rated openings:
 - 1. Provide hardware for fire-rated openings in compliance with A.I.A. (NBFU) Pamphlet No. 80, NFPA Standards NO. 101, FBC-Latest Edition and UL10C. This requirement takes precedence over other requirements for such hardware. Provide only hardware that has been tested and listed by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 - 2. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating Fire Door to be equipped with fire exit hardware and provide UL label on exit device indicating "Fire Exit Hardware". All exit doors accessing the SIDA area (Apron) shall be equipped with delayed egress panic devices and the Contractor shall coordinate all electrified hardware with the fire alarm, the Airport's security and access control system and verify compatibility and function of the door hardware.

1.2 ITEMS SPECIFIED IN OTHER SECTIONS

- A. Hardware for the following items is specified as a part of the items in their respective Specification Sections or in the Base Building Specifications.
1. Glass and Glazing-Section .
 2. Automatic Doors
 3. Rough Carpentry.
 4. Access Panels.
 5. Division 16 for Electrical, Fire Alarm interface, and access control requirements.

1.3 SUPPLIER

- A. Finish Hardware shall be furnished by a hardware contractor/supplier approved by the Architect as having appropriate technical knowledge and experience to correctly interpret drawings and specifications. Supplier shall be prepared at all times during the progress of installation to promptly provide competent and efficient DHI-certified Architectural Hardware Consultant, "AHC", to approve its complete installation in order that all items shall be installed in the best manner and function properly. This will necessitate a job visit to certify the hardware installation prior to final inspection. The Contractor/Supplier shall be bona-fide direct distributor of all material furnished.

1.4 TYPE AND QUALITY

- A. For purposes of designating type and quality of work of this Section, specifications are based on products of companies named. Products of other manufacturers may be approved if submitted for consideration, in accordance with Section 01600 – Materials and Equipment prior to bid date and approved by Addendum.

1.5 DELIVERY

- A. All items of Finish Hardware shall be delivered to the project site, or as otherwise specified or required, and shall be checked in for completeness and familiarization with the Contractor. All items of Finish Hardware shall be packaged, numbered, labeled to identify each opening for which it is intended, and to correspond with item numbers on the approved Hardware Schedule.

1.6 INSTALLATION

- A. All Finish Hardware to be installed on or in metal doors and/or frames shall be manufactured to template. Template machine screws shall be furnished for all such materials. This supplier shall furnish Hardware Schedule as approved by the Architect and all necessary templates to metal door and frame fabricators for their coordination use.
- B. Coordinate with the General Contractor and the security access control contractor the location of required conduits and electrical devices required for the operation

and function of electrical hardware components, including but not limited to power for transformers, electric locks, magnetic hold open devices, delayed egress at secured doors with panic devices and security system hardware.

1.7 SCHEDULES AND SUBMITTALS

- A. Submit six (6) complete typewritten Hardware Schedules to the Architect and Owner for acceptance. After acceptance, provide required number of copies of accepted Hardware Schedule for distribution. No factory order shall be placed for materials until acceptance has been given by the Architect.
- B. Two current copies of catalog cuts shall be submitted with the Hardware Schedule for each item of the Hardware listed in the Schedule.
- C. Each item in the Schedule shall be identified on the first page of the Schedule by the manufacturer's name.
- D. Submit a separate detailed keying schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- E. Provide sample lever sets for installation and verification of required clearances and mounting heights on panelized doors, or doors with applied trim.
- F. Provide door hardware manufacturer's written certification at completion of the project, and certification that doors meet FBC ADA compliance.

1.8 RESPONSIBILITY

- A. It shall be the Contractor/Supplier's responsibility to furnish Hardware in accordance with the intent of this Specification. Where, by virtue of Architectural design or by function, a change is necessary, Hardware of equal design and quality shall be furnished upon written approval of the Architect and Owner.
- B. All Hardware shall meet the requirements of applicable codes. i.e. Underwriters Laboratory, International Building Code, and the local Fire Marshall.

1.9 TEMPLATES

- A. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
 - 1. After hardware schedule has been approved, furnish templates required by manufacturing contractors for making proper provisions in their work for accurate fitting and finishing hardware setting. Furnish templates in ample time to facilitate progress of work.

1.10 QUALITY ASSURANCE

- A. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.
- B. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction.
- C. Door undercuts & Thresholds: Verify door undercut requirements and clearance heights for thresholds or finished floor elevations, and compliance with door rating requirements, as approved by the local Fire Marshall.

1.11 WARRANTY

- A. In addition to the Manufacturer's warranty on all products and finishes on products specified in the Section, the Contractor/Supplier shall provide a warranty against defects in installation and workmanship for a period of (1) one year from the date of substantial completion of the building.
- B. Provide the following manufacturers written warranty:
 - 1. Locks & Latches: Three 3 years.
 - 2. Closers: Ten (10) years.
 - 3. Exits Devices: Three (3) years.
- C. Refer to Division 01 Project Closeout Section for additional and detail requirements.

1.12 LOCATIONS

- A. Hardware locations and maximum dimensions shall be as follows:
Distance from finish floor to center line of:

Door Knob	38" (96.5 cm)
Door Pull	42" (107 cm)
Deadlock	45" (114 cm)
Exit Bolt Cross Bar	38" (96.5 cm)
Push Plate	50" (127 cm)
Butt Hinges	Bottom Hinge - Finish floor to bottom of hinge 10" (25.4 cm). Top Hinge - Head rabbet to top of hinge 5" (12.7 cm). Center Hinge - equal distance between top and bottom hinges.

- B. Hardware locations shall be confirmed on panelized and trimmed doors. Verify that the levers will clear projected trim or moldings, and that the mounting heights will comply with FBC and Accessibility requirements.

1.13 180 DEGREE OPENINGS

- A. Other than those doors that are restricted to less than 180 degree opening by building or by overhead holders or stops, all butts and/or closer arms shall be of sufficient size to allow full 180 degree opening of doors.

1.14 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule.
- C. Provide secure lock-up for door hardware delivered to the Project. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. To the greatest extent possible, obtain each kind of hardware from only one manufacturer.
- B. All numbers and symbols used herein have been taken from the current catalogues of the following manufacturers.

PRODUCT	ACCEPTABLE MANUFACTURER	ACCEPTABLE SUBSTITUTE
1) Hinges	Hager	Ives, Stanley
2) Locks & Latches	Schlage	Sargent, Best
3) Door Closers	LCN	Corbin Russwin, Sargent
4) Exit Device	Von Duprin	NONE
5) Automatic Operators	LCN	Stanley, Horton
6) Wall Stops/Floor Stops, Flushbolts	Rockwood	Ives, Trimco
7) Kick Plates	Rockwood	Ives, Trimco
8) Threshold/Weather-strip	National Guard Products	Pemko, Zero, Reese, Hager

- 9) Silencers Ives Trimco, Rockwood
- 10) Wall mounted mag locks Security Door Controls or approved equal

C. If material manufactured by other than that specified or listed herewith as an equal, is to be bid upon, permission must be requested from the Architect prior to bidding in accordance with Section 01600 – Materials and Equipment. If substitution is allowed, it will be so noted by addendum.

2.1 BUTT HINGES

- A. Doors 1-3/4" (4.4 cm) over 3'- 6" (1.07 m) in width and doors designated as high frequency (see Door Schedule) extra heavy weight (4) ball bearing 5" (12.7 cm) high.
- B. Doors 1-3/4" (4.4 cm) thick - minimum 4- 1/2" (10.2 cm) high.
- C. Doors 1-3/8" (3.49 cm) thick - minimum 3-1/2" (10.2 cm) high.
- D. Each door shall have not less than three hinges. Doors 7'-6" (2.29 m) and higher shall have four hinges whether specified under items or not.
- E. All exterior out-swinging doors to have non-removable pins except where modified in the Hardware Schedule.
- F. All butts used with door closers shall be ball bearing. All exterior doors shall have ball bearing butts, except as otherwise specified.

2.2 LOCKSETS/DEADLOCKS

- A. Shall be the following manufacturers and shall be furnished in the function as specified in the Hardware Sets. Products shall be provided as specified, substitutions will be considered in accordance with provisions of the Substitutions and Product Options Section in Division 01.

<u>Manufacturer</u>	<u>Series</u>
Schlage	L9000 Series
Best	45H Series
Sargent	8200 Series

- B. All levers, escutcheons and cylinders shall be the product of the manufacturer. Levers shall comply with required FBC Accessibility requirements.
- C. Lockset latch bolt throw 3/4" (1.27 cm).
- D. Electric Strikes and Locks (Where required for secured or access controlled doors):
 - 1. Provide electrically controlled locks and transformers where card reader or secured doors are indicated on the Drawings, scheduled or required as part of Building security requirements, and shall be compatible with the Airport's access control system.

2. Coordinate control with swipe card or proximity readers provided by Owner's security contractor.
3. Verify voltage provided to mag locks will not cause damage to the lock or failer to operate or overheating.
4. All electrically locked doors shall be provided with a pushbutton release for emergency egress, on the secured side of the door; power supply and transformers shall be furnished and installed for operation of all electric door locks specified or scheduled. Electric magnetic locks shall be compatible with the Airport's security system.

2.3 EXIT DEVICES

- A. All devices shall be rim or vertical rod in type and function as specified. Devices must be listed under "Panic Hardware" in accident equipment of Underwriters Laboratories. All labeled doors with "Fire Hardware" must have labels attached and be in strict accordance with Underwriters Laboratories. Pulls and dummy trim shall be lever type. Panic devices shall be equipped with a 15 second delay at doors accessing secured areas and shall be coordinated and compatible with the Airport's security system.

<u>Manufacturer</u>	<u>Series</u>
Von Duprin	99

2.4 DOOR CLOSERS

- A. Closers shall be one of the following manufacturers or approved equal and shall be furnished in the manufacturer's recommended printed size for the specified condition unless otherwise noted in the Hardware Sets. Closers shall be full rack and pinion complete with back check. Springs shall be motor clock type. Furnish flush mount transom brackets where no transom bar exists. Furnish parallel arm where required. Closers shall be required on all rated doors; spring hinges shall not be allowed, unless approved by the Architect. Sentronic series closers shall be tied to the fire alarm and shall automatically release the door in the event of a fire alarm, and shall be 120V powered and shall be provided with a metal cover for custom finishing.

<u>Manufacturer</u>	<u>Series</u>
LCN	4040XP
Corbin Russwin	DC8000
Sargent	281

- B. Furnish door closers with proper arms and/or brackets to avoid conflict with door lites and/or low ceiling reveals.

- C. Door closer cylinders shall be of high strength cast iron construction to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory.
- D. Door closers shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees Fahrenheit to -30 degrees Fahrenheit, without requiring seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with the standards FBC (latest Authority Having Jurisdiction accepted edition) and UL 10C.
- E. Door closers shall incorporate tamper resistant non-critical screw valves of V-slot design to reduce possible clogging from particles within the closer. Closers shall have separate and independent screw valve adjustments for latch speed, general speed, and hydraulic back check; Back check shall be properly located so as to effectively slow the swing of the door at a minimum of 10 degrees in advance of the dead stop location to protect the door frame and hardware from damage. Pressure relief valves (PRV) are not acceptable.
- F. All fire-rated doors shall receive automatic door closers.
- G. Closers shall be mounted such that the closer unit and arm are concealed and not visible from finished common/public areas. Confirm and coordinate with the Architect on the location of closers, prior to initiating installation and frame hardware prep.

2.5 AUTOMATIC OPERATORS

- A. Automatic Operators shall be one of the following manufacturers or approved equal and shall be furnished in the manufacturer's recommended printed size for the specified condition unless otherwise noted in the Hardware Sets. Auto operators shall comply with ANSI/BHMA A156.19. Power opening and spring closing capable of meeting ANSI A117.1.

<u>Manufacturer</u>	<u>Series</u>
LCN	4640 Series
Stanley	Magic Force
Horton	4000LE

2.6 DOOR TRIM

- A. All push plates, pulls, pull plates, kick plates and/or armor plates shall be any one of the following manufacturer's products or approved equal in catalog number as set forth herein.

<u>Manufacturer</u>
Rockwood
Ives

Trimco

- B. Stainless steel plate material shall be minimum .050 gauge thick.
- C. Provide stainless steel kick plates where scheduled or directed by the Architect at high impact doors and where door finishes will be damaged by carts or high usage. Kick plates to be 10 inches (254 mm) high; or fit to the bottom rail of the door type scheduled.

2.7 SILENCERS

- A. All interior wood and metal door frames shall have door silencers Type 64 or 65, three per single door, two per pair of doors.

2.8 STOPS, HOLDERS, AND LOCK GUARDS

- A. Stops shall be of the following manufacturers or approved equal:
 - 1. Ives.
 - 2. Rockwood.
 - 3. Glynn-Johnson.
 - 4. Rixson
- B. Provide magnetic hold open devices at all rated doors schedule to remain in an open position, where shown or scheduled in the Drawings. Hold open device hardware shall be fully concealed and not visible on the public side of the door, when in an open position.
- C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall bumpers equal to Ives WS407 Series are preferred, but where not practical furnish floor stops equal to Ives FS436 or FS438 series. Where conditions prohibit the use of either wall or floor type stops, furnish surface mounted overhead stops equal to Glynn Johnson, 450 Series. Heavy duty floor stops shall be provided at exterior doors.
- D. Lock guards shall be provided at all exterior doors with locksets.

2.9 THRESHOLDS AND DOOR STRIPPING PRODUCTS

- A. Thresholds, where scheduled or required for thermal performance enhancement of an exterior door opening, shall be of the following manufacturer's or approved equal. See Hardware Schedule for types required.
 - 1. Zero Weatherstripping Co., Inc.
 - 2. Pemko Manufacturing Co.

3. Reese Enterprises, Inc.
 4. Hager.
 5. National Guard.
- B. Thresholds shall be low profile, ADA compliant type thresholds throughout. Metal thresholds shall not be provided at stone or tile floors in Areas, thresholds for these locations shall be stone or marble, where thresholds are required or shown on the Drawings. Exterior door thresholds shall be set in a full bed of sealant.
- C. Provide sound rated hardware consisting of door sweeps, thresholds (or auto door bottoms) and concealed door bottom gaskets at base of all sound rated doors where shown or scheduled on the Drawings.
- 1) At frames, surface-applied-self-adhesive sound gaskets shall be equal to Pemko – S88, Black, or approved equal.
 - 2) Provide concealed-sound-rated auto-door-bottoms, Pemko- 434 RL, or approved equal at sound rated doors.

2.10 KEYING

- A. All locks shall be master keyed as directed by the Architect or Owner. Submit a proposed keying schedule for approval. Furnish six (6) master keys and two (2) keys for each lock. All locks shall be construction keyed. Furnish four (4) construction master keys. Keys shall be mastered keyed to the Airport Building Standard.
1. Hardware supplier to provide temporary cylinders or cores during the construction phase and or construction keyed cylinders as scheduled. The contractor is to change out the temporary cylinders for the permanent cylinders.
 2. Coordinate keying with the Airport where applicable.

2.11 FASTENINGS

- A. All screws shall be of matching finish to their product and shall be the manufacturer's standard for that item.
- B. Sex Bolts - Door closers, door holders, and exit devices installed on wood doors shall be attached by means of the bolts and sex nuts.

2.12 KEY CABINET

- A. Furnish a key cabinet complete with accessories to accommodate all keys.

<u>Manufacturer</u>	<u>Model No.</u>
Telkee	AWC-250-S

- B. Prepare and furnish the Owner with complete index of keys as directed by the Architect. Tag and file all keys in cabinet location as directed by the Architect. Hardware supplier shall deliver keys, index lists, and cabinet, set-up and assembled to the jobsite.

2.13 FINISHES

- A. Where not specifically called out in the Finishing Manuals, for all non-public access areas and exterior doors, provide hardware items in finish US32D Stainless Steel in, or as indicated below unless otherwise indicated in hardware sets.

1.	Butts – Exterior	US32D
2.	Butts - Interior	US26D
3.	Locks	US26D
4.	Push/Pulls, Kickplates, Lock Guards	US32D
5.	Closers	Match door frame or Spray painted to match hardware per Architect's approval.
6.	Door Stops & Miscellaneous	US32D
7.	Exit Devices	US26D

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 Sections. Do not install surface mounted items until finishes have been completed on the substrate.
- B. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- D. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly as intended for the application made.

- E. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.
 - F. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Protection,"
- E. Weather-stripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING AND CLEANING

- A. Contractor shall adjust all hardware in strict compliance with manufacturer's instructions. Prior to turning over the project to Owner, Contractor shall clean and make any final adjustments to the finish hardware.
- B. Hardware locations shall be as recommended by the Door Hardware Institute, 4 copies of the brochure shall be forwarded to the General Contractor.
- C. Closer adjustment: A representative of the closer manufacturer shall visit jobsite, adjust and regulate all closers and inspect to see that they are installed according to factory recommendations and Florida Building Code (ADA) requirements and shall provide written certification of compliance.
- D. Manufacturer's or Architectural Hardware Consultant's certification letter of project requirements shall be provided at the completion of the project.
- E. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- F. Clean adjacent surfaces soiled by hardware installation.

3.3 PROTECTION

- A. Contractor shall protect hardware as it is stored on construction site in a covered and dry place.
- B. Contractor shall protect exposed hardware installed on doors during the construction phase.

3.4 HARDWARE SCHEDULE

- A. Submit required Hardware Schedule per Article 1.8 of this Section.
- B. Change-out all temporary construction key cylinders once the locked space has been finished, and all construction work has been completed and accepted by the Owner and the Architect.

4.0 HARDWARE SETS:

A. The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors or for each single door. The Contractor shall verify the function, operation and compatibility of all electrified hardware with the Owner's security access control and the fire alarm systems.

B. Manufacturer index:

ACC = Accurate Lock	SCH = Schlage Lock
FRA = Frascio International	STA = Stanley
FSB = FSB USA	VON = Von Duprin
GLY= Glynn-Johnson	ZER = Zero International
IVE = Ives	LAR = Length As Required
LCN = LCN Closers	LDW = Less Door Width
PEM = Pemko	SCH = Schlage Lock
RIX = Rixson	STA = Stanley
B/O = By Door Manufacturer	SDC = Security Door Controls

* NOTE: All levers to be antimicrobial "AM"

SET 01

HARDWARE BY DOOR SUPPLIER

SET 02

3 EA HINGES	BB1191 – 4.5 X 4.5 NRP	630	HAGER
1 EA EXIT DEVICE	99NL-OP	626AM	VON DUPRIN
1 EA I/C CYLINDER	AS REQUIRED	626	SCHLAGE
1 EA PULL	BF158	***	ROCKWOOD
1 EA CLOSER	4040XP X SCUSH	689	LCN
1 SET WEATHERSTRIP	160S	AL	NGP
1 EA SWEEP	200N	AL	NGP
1 EA THRESHOLD	425	AL	NGP
1 EA DRIP STRIP	16A	AL	NGP

**PROVIDE DOOR PULL WITH US32DMS FINISH.

SET 03

3 EA HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA OFFICE LOCK	L9050R X 06A	626AM	SCHLAGE
1 EA WALL STOP	409	630	ROCKWOOD

SET 04

1 EA	CONTINUOUS HINGE	780-112HD	CLR	HAGER
1 EA	EXIT DEVICE	CD33A-NL-OP	626	VON DUPRIN
2 EA	I/C CYLINDER	AS REQUIRED	626	SCHLAGE
1 EA	PULL	BF158	***	ROCKWOOD
1 EA	AUTO OPERATOR	4640	689	LCN
2 EA	ACTUATOR	8310-856T	630	LCN
2 EA	FLUSH MNT BOX	868F	---	LCN
1 EA	WEATHER RING	8310-800	---	LCN
1 EA	OVERHEAD STOP	GJ100 SERIES	630	GLYNN-JOHNSON
1 EA	SWEEP	200N	AL	NGP
1 EA	THRESHOLD	425	AL	NGP

**SEALS BY DOOR SUPPLIER.

**PROVIDE DOOR PULL WITH US32DMS FINISH.

**AUTO OPERATOR WILL ONLY FUNCTION WHEN EXIT DEVICE IS DOGGED DOWN.

SET 05

3 EA	HINGES	BB1191 – 4.5 X 4.5 NRP	630	HAGER
1 EA	CLASSROOM LOCK	L9070R X 06A	626AM	SCHLAGE
1 EA	CLOSER	4040XP X SCUSH	689	LCN
1 SET	SEALS	5050C	BLK	NGP
1 EA	SWEEP	200N	AL	NGP
1 EA	THRESHOLD	425	AL	NGP

SET 06

3 EA	HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA	CLASSROOM LOCK	L9070R X 06A	626AM	SCHLAGE
1 EA	CLOSER W/HOLD	4040XP-H	689	LCN
1 EA	WALL STOP	409	630	ROCKWOOD
1 EA	KICKPLATE	10" X 2" LDW	630	ROCKWOOD

SET 07

3 EA	HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA	PUSH	70C	***	ROCKWOOD
1 EA	PULL	BF111 X 70C	***	ROCKWOOD
1 EA	CLOSER	4040XP	689	LCN
1 EA	WALL STOP	409	630	ROCKWOOD
1 EA	KICKPLATE	10" X 2" LDW	630	ROCKWOOD

**ALLOW 180 DEGREE SWING.

**PROVIDE PUSH/PULL WITH US32DMS FINISH.

SET 08

3 EA	HINGES	BB1191 – 4.5 X 4.5 NRP	630	HAGER
1 EA	OFFICE LOCK	L9050R X 06A	626AM	SCHLAGE

JONESBORO MUNICIPAL AIRPORT
MAINTENANCE HANGAR RECONSTRUCTION

FEBRUARY 2021
CONSTRUCTION SET

1 EA CLOSER	4040XP X SCUSH	689	LCN
1 SET SEALS	5050C	BLK	NGP
1 EA SWEEP	200N	AL	NGP
1 EA THRESHOLD	425	AL	NGP

SET 09

6 EA HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA STOREROOM LOCK	L9080R X 06A	626AM	SCHLAGE
2 EA CLOSER	4040XP X SCUSH	689	LCN
1 SET AUTO FLUSHBOLTS	FB31P	630	IVES
1 EA DUSTPROOF STRIKE	DP2	626	IVES
1 EA COORDINATOR	COR X FL	628	IVES
2 EA MNTG BRACKETS	AS REQUIRED	628	IVES
1 SET SEALS	5050C	BLK	NGP
1 EA ASTRAGAL	BY DOOR SUPPLIER		

SET 10

3 EA HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA CLASSROOM LOCK	L9070R X 06A	626AM	SCHLAGE
1 EA OVERHEAD STOP	GJ450 SERIES	630	GLYNN-JOHNSON

SET 11

3 EA HINGES	BB1191 – 4.5 X 4.5 NRP	630	HAGER
1 EA STOREROOM LOCK	L9080R X 06A	626AM	SCHLAGE
1 EA CLOSER	4040XP X SCUSH	689	LCN
1 SET SEALS	5050C	BLK	NGP
1 EA SWEEP	200N	AL	NGP
1 EA THRESHOLD	425	AL	NGP

SET 12

3 EA HINGES	BB1279 – 4.5 X 4.5	652	HAGER
1 EA STOREROOM LOCK	L9080R X 06A	626AM	SCHLAGE
1 EA OVERHEAD STOP	GJ90 SERIES	630	GLYNN-JOHNSON

END OF SECTION 08710

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SECTION 08800 – INTERIOR GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes interior glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors with glazing where scheduled or shown.
- B. Related Sections:
 - 1. Division 8 Section "Aluminum Entrances, Window Walls and Exterior Glazing" for exterior glazing.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.1 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass and glazing products, from manufacturer.

1.2 QUALITY ASSURANCE

- A. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, fully tempered, Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- B. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F1 (patterned one side).
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide pattern, frosted, or fluted glass as scheduled or comparable product by one of the following:
 - a. Guardian Industries
 - b. Pilkington Glass
 - c. PPG Industries

2.3 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

2.4 GLAZING GASKETS

- A. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM or silicone gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- B. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 999-A.
 - b. GE Advanced Materials - Silicones; Contractors SCS1000 Construction SCS1200.
 - c. Tremco Incorporated; Proglaze Tremsil 200.
 - d. BASF Building Systems; OmniPlus.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other

glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.8 MONOLITHIC-GLASS TYPES

- A. Refer to door schedule for glass type, pattern, rating, and clear glass. All glass in doors and side lights adjacent to doors shall be tempered glass.
- B. Glass Type GL-CLR: Clear fully tempered float glass (where scheduled or shown on the drawings).
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.
- C. Glass Type GL-Plate Fluted – Shall be Tempered patterned glass, where shown or scheduled.

2.9 FIRE-PROTECTION-RATED GLAZING TYPES AT RATED DOORS

- A. Glass Type GL-FG: 20-minute coordinated with the rating of the wall or door installed and fire-rated glazing with 450 deg F temperature rise limitation; laminated glass with intumescent interlayers at fire rated doors with ratings or located within rated walls.
 - 1. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when

installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.7 CLEANING AND PROTECTION

- A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- B. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

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

END OF SECTION 08800

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SECTION 08905 – ALUMINUM ENTRANCES, WINDOW WALLS AND EXTERIOR GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Description of the Work:

1. Furnishing and installation of aluminum-framed entrances, exterior aluminum windows and/or window walls and exterior glazing for the conditions outlined by the Drawings or requirements of the specifications.
2. Provide labor, materials, equipment and related items as shown on Drawings and as specified. Provide items not specifically mentioned but necessary to complete the work, including, but not limited to:
 - a. Anchorage to building structure, including the bracing to the primary building structure where required to provide support for forces imposed by work of this section, furnishing of embeds (where required) for installation by General Contractor based on the layout drawing furnished by the glass and glazing Installer/subcontractor.
 - b. Special fabrication and reinforcing of segmented framing, sills and sub-sill flashing, where shown or required.
 - d. Sealants within work of this section and at boundaries with work of other sections.
 - e. Glass visual mock-ups.
 - f. Field quality control tests.

1.3 RELATED 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:
 1. Division 3 Section "Cast-In-Place Concrete."
 2. Division 4 Section "Unit Masonry Assemblies."

2. Division 7 Section "Caulking and Sealants."
3. Division 8 Section "Sliding Automatic Entrance Doors."
4. Division 8 Section "Interior Glazing."
5. Division 9 Section "Gypsum Board Assemblies."

1.4 REFERENCES

- A. Except as otherwise specified, comply with:
1. Aluminum Association (AA)
 - a. Aluminum Design Manual.
 - b. Aluminum Standards and Data.
 2. American Institute of Steel Construction (AISC)
 - a. M-016 Manual of Steel Construction Allowable Stress Design, Ninth Edition.
 3. American Iron and Steel Institute (AISI)
 - a. Specification for the Design of Cold-Formed Steel Structural Members.
 - b. Stainless Steel Cold-Formed Structural Design Manual.
 4. American Society of Civil Engineers (ASCE)
 - a. ANSI/ASCE-8 Specification for the Design of Cold-Formed Stainless Steel Structural Members.
 5. American Welding Society (AWS)
 - a. D1.1 Structural Welding Code--Steel.
 6. American Concrete Institute (ACI)
 - a. Building Code Requirements for Reinforced Concrete (ACI 318)
 7. American National Standards Institute (ANSI)
 - a. ANSI Z97.1 Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings
 - b. ANSI/SMA 1004 Specifications for Aluminum Tubular Frame Screens for Windows.

8. Glass Marketing Association of North America (GANA) Glazing Manual.
9. General Services Administration
 - a. GSA Specification TT-P-645B for Alkyd Type Zinc Chromate Primer Paint.
 - b. FS-RR-W-365 Federal Specification Wire Fabric (Insect Screening).
10. American Architectural Manufacturers Association (AAMA)
 - a. AAMA/NWWDA 101/I.S.2 Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
 - b. AAMA 501.1 Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure.
 - c. AAMA 502 Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage.
 - d. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
 - e. AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels for powder coatings, where provided.
 - f. AAMA 2605 Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels for Kynar coatings, where provided.
 - g. AAMA TIR-A9 Metal Curtain Wall Fasteners.
11. ASTM International (ASTM)
 - a. A 36 Specification for Carbon Structural Steel.
 - b. A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. A 500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - d. A 501 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - e. A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

- g. B 244 Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
- h. C 509 Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
- i. C 794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- j. C 864 Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- k. C 1036 Specification for Flat Glass.
- l. C 1048 Specification for Heat-Treated Glass--Kind HS, Kind FT Coated and Uncoated Glass.
- m. C 1087 Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- n. C 1115 Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
- o. C1172 Standard Specification for laminated Architectural Flat Glass
- p. C 1248 Test Method for Staining of Porous Substances by Joint Sealants.
- q. C 1376 Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass
- r. C 1521 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- s. D 2244 Test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates.
- t. D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
- u. E 283 Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- v. E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- w. E 331 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

- x. E 987 Standard Test Methods for De-glazing Force of Fenestration Products.
- y. E 1300 Standard Practice for Determining Load Resistance of Glass in Buildings.

12. Insulating glass certification council (IGCC) CBA.

1.5 SUBMITTALS

A. Submit drawings and product data under provisions of Section 01300 and as further described in this section.

B. **Preliminary Submittal:** Submittals for information only, shall be as described below. Upon request, promptly submit additional information and clarification of intent.

1. Submit paint manufacturer's approval of paint applicator, as required for warranty.
2. Proposed paint manufacturer's warranty for coating system.
4. Sealant system technical data sheet proposed for the project.
5. Provide written statement of full compliance with the Drawings and Specifications. If deviations are proposed, provide an itemized list of specification and architectural drawing requirements which are not embodied in contract, or intended contract, for work of this section. Identify specification page and paragraph, or architectural drawing sheet, elevation, plan, section or detail for each item. Deviations not specifically identified shall not be deemed valid in submittal review. Failure to provide either a statement of full compliance or an itemized list of deviations shall, at reviewers' discretion, shall be cause for return of preliminary submittals without review. Where NOA (Notice of Approval) lists more than one option, indicate clearly on the preliminary submittal which option is proposed for use on the project.
6. Written certification from the glass and aluminum manufactures that materials that are being provided are manufactured and fabricated domestically, within the United States.

D. **Shop Drawing Submittals:** Submittals for approval, submittals shall be complete and in required form. Resubmittals shall include requested corrections and shall respond to previous comments. Each revised sheet shall bear a revision date and number. Revisions shall be flagged with conspicuous revision symbols and numbers. Failure of submittals to be complete, in the proper form, responsive to comments, or identify revisions shall be cause for disapproval and return of documents without review. Failure of review comments to note a noncompliance with plans and specifications shall not relieve the Contractor from his obligation to comply.

1. Failure of review comments to note a noncompliance on a given submittal shall not preclude a directive to comply on future submittals. A maximum of two reviews will be performed without additional cost to the Contractor. If a submittal does not achieve an approved status by the second submittal, cost of additional reviews by Architect and Consultant shall be borne by Contractor
2. Submit drawings showing materials in place on building. Drawings shall include elevations, floor plans, sections and full size details. Details shall be fully drawn (not outlined). Drawings shall include the following information.
 - a. Identify those products which, by Code, are subject to "impact" testing requirements or are required to have Product-Notice of Approval. and/or Product Label.
 - b. Joinery and internal seals (details showing sill flashing, head receptors, sill and mullion intersections with details of sealing) as required for special conditions of window wall assembly.
 - c. Identify products (by name and manufacturer) and provide details for any required thermal insulation and/or safing insulation.
 - d. Metal alloy, temper, thickness, and finish.
 - e. Glass thickness, strength, tint, and coating.
 - f. Fastener alloy, strength, plating, diameter, length and spacing.
 - g. Glazing materials identification
 - h. Sealant identification by product name.
 - i. Dimensions of the window wall assembly, relative to the layout of adjoining walls, beams, columns and slabs.
 - j. Dimensioned position of glass edge relative to metal daylight.
 - k. Provisions for movements and for internal reinforcement, where required
 - l. Locations of, and details for, embedded anchors
 - m. Location, manufacturer's part #, and samples or manufacturer's cut sheets for all hardware, thresholds and locking devices.
 - n. Weld information and weld symbols conforming to AWS conventions.
 - o. Glazing details applicable to replacement glass, with outline of procedure for glass replacement, to be provided as part of closeout documents.
 - p. Anchor details, showing provisions for adjustment of anchors to accommodate specified building structure tolerances..

- q. Sample of coating manufacture's specific project warranty certification and approval of applicator.
 3. Submit glass manufacture's wind pressure analysis, thermal stress analysis, and manufacture's written review of shop drawings stating that details including glass products are suitable for the proposed use, including Code required "impact" resistance, glass bite, support clearances, air circulation on interior and consideration of the effects of exterior shading
 4. Submit sealant manufacture's test reports confirming sealant adhesion, compatibility and absence of staining of adjacent materials. Submit application and quality control procedures for sealants.
 5. Submit laboratory test reports for thermal tests performed in accordance with AAMA 1503.
 6. Submit record drawings as part of contract close-out documents, showing all changes made during construction.
 7. Submit written certification from the installing contractor that hardware and door operating pressures comply with IBC accessibility code requirements for door operation.
- E. Samples:
1. Submit for approval four (4) sets of labeled samples of each type and color of metal finish, on 12 inch long sections of extrusion shapes and 12 inch squares of sheet metal. Samples shall show extremes of color and texture variation. Samples will be reviewed by the Architect for color and texture only. Compliance with other requirements is the responsibility of the Contractor.
 2. Submit for approval four (4) sets of labeled 12 inch square samples of each type of glass. Provide, at project, site visual mock-up using full size glass, for evaluation of color range and distortion of reflected image.

1.6 QUALIFICATIONS

- A. Aluminum Fabricator: Company specializing in fabrication of architectural aluminum extrusions and sheet with satisfactory completion of similar work and of adequate financial responsibility. Engineer providing structural design shall be licensed in the State the work is to be completed and have experience designing architectural aluminum.
- B. Glass Supplier and Fabricator: Company specializing in manufacture of flat glass and fabrication of architectural glass.
- C. Gasket Supplier: Company specializing in manufacture of products specified in this section.

- D. Sealant Supplier: Company specializing in manufacture of products specified in this section.
- E. Installer: Company specializing in performing work of this section.

1.7 DESIGN REQUIREMENTS

- A. Contract Documents define design intent and performance requirements. Details show intended relationships and preferred profiles. Contractor shall develop and provide final design details and shall be fully responsible for the conformance of the installed work to the design criteria herein.
- B. Unless otherwise defined by Contract Documents, appearance of exposed elements, including width and depth, shall be consistent throughout the project for similar or like window opening conditions and/or configurations.
- C. Unless otherwise defined by Contract Documents, overall thickness of each glass type, and component thickness of multiple layer glass types, shall be consistent throughout the project for similar or like conditions.
- D. Provide anchor adjustment capability for full range of specified tolerances for building structure, but not less than one inch in all directions, or dimensional requirements to accommodate construction tolerances of concrete and masonry openings in accordance with the Specifications.
- E. Design wind pressures shall be in compliance with Authority Having Jurisdiction wind pressure maps, FBC, and the Structural Drawings. Block diagrams are shown on the Structural Drawings.
- F. Wind pressures act perpendicular to flat surfaces, regardless of surface orientation. Wind pressures act perpendicular to tangents of curved surfaces. At corners and other changes in plane, either the inward pressure or the outward pressure shall be assumed to affect the two adjoining surfaces simultaneously. Design for simultaneous occurrence of inward pressure on one surface and outward pressure on adjoining surface is not required.
- G. Structural elements of the work shall meet the requirements of applicable state and local codes.
- H. Framing Members:
 - 1. Glass, sealants and interior finishes shall not be assumed to contribute to framing member strength, stiffness or lateral stability.
 - 2. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from (a) anchors to building structure and (b) horizontal glazing rails or interior trim which contact the compression flange. Points of contra-flexure shall not be regarded as lateral braces or as end points of an unbraced length; unbraced length shall be the distance between effective lateral braces.

3. Where a framing member reaction is resisted by a continuous element, maximum assumed effective length of resisting element shall be four times the bearing length, but not more than one foot.
 4. Splice joints permitting movement shall be assumed to have zero moment capacity.
 5. Where a framing member runs continuously past a deflecting support, combined deflection of member and support shall not exceed specified limits.
 6. Thermal breaks are not required and, if provided, shall be assumed to have no ability to transfer shear stress for composite action of flexural members (elements joined by a thermal break shall be assumed to act separately).
- I. Fasteners
1. General Requirements
 - a. Quantity, spacing and length of fasteners shall be designed and engineered by the window wall manufacturer for specific jamb, head and sill conditions consistent with the wind loading criteria as shown on the structural drawings.
 - b. Tension shall be taken as sum of direct tension plus tension due to prying.
 - c. Penetrations of a shim stack with total thickness "t" by a fastener with nominal diameter "d" shall require reductions in allowable tension and shear forces. Minimum reduction shall be zero percent for $t=d$, varying linearly to 100 percent for $t=2d$. Such reduction shall be in addition to any other reductions which may be applicable. An acceptable alternative method is to assume that shims provide no resistance to fastener bending, compute fastener bending stress with cross sectional properties based on root diameter, add bending stress to tension stress, and evaluate tension/shear interaction. Allowable stress for bending shall be the same as allowable stress for tension per standard engineering analysis.
 - d. Unless otherwise specified, combined tension and shear shall be evaluated according to an interaction formula in which each term equals the square of actual force divided by the square of allowable force. Sum of terms shall not exceed 1.0.
 2. Allowable stresses for aluminum fasteners shall comply with Aluminum Design Manual.
- J. Glass:

1. Wind pressure shall be treated as short duration load and gravity loads shall be treated as long term load, as defined by ASTM E 1300.
 2. Probability of breakage upon first application of design pressures shall not exceed 8/1000 for vertical glass, and 1/1000 for sloped and horizontal glass. Glass strength and size shall conform to code and ASTM E 1300.
 3. Provide heat treated glass where annealed glass would be vulnerable to thermal breakage.
 4. Spandrel glass units where shown or indicated on the Drawings to comply with adjacent glazing criteria. Color and tint to match adjacent glazing; tint color shall be bronze or color as selected by the Architect from full range of glass colors. Spandrel glass will not be an acceptable substitute for frosted glass, where shown or required by the contract documents.
- L. System shall be designed to support its own weight in combination with other specified pressures and loads.
- M. Movements:
1. Provide movable joints (specific and defined provisions acceptable to the Architect), where required, to accommodate all specified building movements, as well as manufacturing tolerance, field tolerance, irregularities in adjacent surfaces, thermal movement, wind sway, floor sag, beam sag and column shortening. Except where otherwise specifically defined by the Structural Engineer, the design allowance for differential beam and/or floor edge sag, live load floor deflection and creep shall be not less than 0.5 inch.

The manufacturer shall confirm with the Building Structural Engineer the live load deflection criteria, before submitting the shop drawings for approval.
 2. Theoretical and as-built glass bite relative to metal frame shall not be less than 0.375 inch and theoretical and as-built glass edge clearance to nearest metal shall not be less than 0.25 inch. Provide minimum 3/16 inch face clearance (glass-to-metal).
 3. Thermal component of joint movement shall be based on minimum material temperature increase of 100 degrees F and decrease of 60 degrees F relative to nominal condition. Assume entire cross section has uniform temperature. Design summer surface temperature is 180 degrees F. All components including adhesives and sealants shall be capable of withstanding without failure design temperatures with simultaneous specified loads.
 4. At any floor, in-plane displacement shall be assumed to occur while floors immediately above and below remain stationary. There shall be no failure or gross permanent distortion of anchors, frames, glass, or stone; gaskets and weatherstrips shall not disengage; weather seals shall not fail.
- N. Systems which rely upon a single line of defense against water infiltration are not acceptable. Provide integral or secondary gutters and weep systems inboard of the

primary line of weather-seal to collect and drain water leakage to the exterior. Window walls, and windows which are internally drained to the sill utilizing integral weeping sill, shall have continuous (permanently spliced and sealed) sill flashing gutters with water-tight, fully sealed (from front to back) to the adjacent building structure at all terminal conditions (or provided with fully sealed metal end caps) and shall have a head rail which collects and contains infiltration at each glazed opening, drained, either directly to exterior or, in a contained and concealed manner, within the system to the flashed and externally drained sill gutter.

Segmented (curved in plan) areas of the work require specific attention to assure both adequate provision for the specified movements and long term provision for the water-tight performance of the segmented wall mullions, heads, sills and their splice details.

Glazing details shall permit glass replacement after initial construction, shall permit reuse of original gaskets, shall permit replacement glass of same nominal size as original glass, and shall not require cutting of framing members or removal of interior finishes.

- O. Vision glass exterior, and spandrel glass shall be replaceable from the exterior.
- P. Snap engaged or slide on components shall be mechanically secured against migration. Snap engaged components shall not serve any primary structural function, such as retention of glass or panels. Snap engaged plastic components are not permitted, except as nonstructural thermal improvement for interior trim. Joints in continuous snap covers and other continuous trim shall have splice sleeves of same material and finish as cover or trim and the locations of all such joints shall be clearly shown on the shop drawings.

1.8 PERFORMANCE REQUIREMENTS

A. Structural Criteria:

- 1. At pressures and loads from zero to 150 percent of design values:
 - a. Framing member residual deflection after pressure or load is removed shall not exceed 1/1000 times distance between supports or 2/1000 times cantilever length.
 - b. At anchors, framing member deflection relative to building structure shall not exceed 0.187 inch, nor 0.125 inch after pressure or load is removed.
 - c. Upon reversal of pressure or load direction, relative movement between two components that are fastened or clamped together shall not exceed 0.187 inch.
 - d. There shall be no disengagement, failure or significant permanent distortion of any component, including glass and gaskets.
- 2. At 100 percent of design pressures and loads :

- a. Unless otherwise stated by code, net deflection perpendicular to enclosure surface for framing members supporting glass or metal panels shall not exceed: $L/180$ pursuant to Florida Building Code.
 - b. Net deflection of framing members parallel to enclosure surface shall not exceed smallest of: 0.125 inch due to dead load; 0.125 inch change in opening size at any point; $1/360$ times distance between supports, not to exceed 0.375 inch.
 - c. Net deflection parallel and perpendicular to enclosure surface for framing members at perimeter sealant joints shall not exceed smallest of values specified above; 50 percent of joint width; movement capacity of sealant.
 - d. Where applicable, metal panel center deflection shall not exceed $1/100$ of the shorter panel dimension.
- B. Sealants used as weather seals shall not experience adhesive or cohesive failure. Sealants shall withstand movements up to the limits prescribed by manufacturers. Exposed sealant surface shall not crack or bubble. Sealant and primers shall not stain adjacent materials. Sealants shall be used only if manufacturers' adhesion, compatibility and stain tests yield favorable results. Sealants shall not be placed against edge of laminated glass interlayer
- C. Glass:
1. Glass shall not experience spontaneous breakage.
 2. Glass coating shall not crack, peel, stain or discolor.
 3. Glass center deflection relative to supported glass edges at 50 percent of specified design pressures shall not exceed one inch. Glass deflection at 1.5 times design pressures shall be limited to prevent disengagement from frame, unless the deflection criteria may be reduced by FBC approved NOA (or FBC product approval) certification of the assembly.
 4. Laminated glass shall not delaminate, stain or discolor.
 5. Glass shall comply with all window wall assembly NOA certification and FBC requirements.
- D. Snap engaged components shall not disengage when subjected to a concentrated force of 10 pounds or during mock-up structural tests.
- E. Window Systems
1. U factor < 0.45 ; SHGC ≤ 0.25 .

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated units and component parts to project site completely identified in accordance with erection diagrams prepared by this contractor.
- B. Store materials in accordance with manufacturer's instruction, above grade on dunnage, properly protected from the weather and construction activities and so located as to facilitate access to, and handling of, all materials, and in accordance with Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.
- C. Replace all damaged materials.

1.10 SEQUENCING

- A. Coordinate with requirements of material and personnel hoists. Defer installation at obstructed areas, and install materials when obstructions are removed.

1.11 WARRANTY

- A. Provide written warranty agreeing to repair or replace defective materials and workmanship during warranty period. Defective materials and workmanship include, but are not limited to:
 - 1. Abnormal deterioration, aging or weathering.
 - 2. Water leakage.
 - 3. Air leakage exceeding specified limits.
 - 4. Failure of operating parts to function normally.
 - 5. Structural failure.
 - 6. Sealant loss of adhesion, loss of cohesion, cracking or discoloration.
 - 7. Disengagement of gaskets, weatherstrips, trim or other accessories
 - 8. Deterioration or discoloration of aluminum finish.
 - 9. Glass breakage including: secondary breakage caused by falling glass; spontaneous breakage of heat treated glass.
 - 10. Delamination or discoloration of laminated glass.
 - 11. Loss of glass bite due to shifting of glass.
 - 12. Loss of glass bearing on setting blocks due to shifting of glass and/or blocks.

- B. Warranty does not include damage caused by vandalism, or by natural conditions exceeding the performance requirements. Warranty and its enforcement shall not deprive Owner of other action, right or remedy.
- C. Warranty period for entire system shall be three (3) years from date of substantial completion, unless otherwise noted; i.e. paint finish warranty. System warranty includes materials and labor.
- D. Certain materials are required to have special warranties. Special warranties shall not limit or reduce requirements of system warranty. Special warranties may originate, in part or in whole, with manufacturers or fabricators and pass through Contractor to Owner. Warranties as written or interpreted by manufacturers or fabricators shall not limit or reduce special warranty requirements of this specification.
 - 1. Painted finish on aluminum which cracks, peels, fades in excess of specified limits or chalks in excess of specified limits shall be replaced at no charge (material and labor) for minimum ten (10) year period beginning on date of manufacture. Coating manufacturer shall provide written confirmation of applicator approval prior to initiation of fabrication.
 - 2. The paint manufacturer shall provide written approval of the paint applicator and ten (10) year warranty; prior to initiation of any fabrication work.
 - 3. Laminated glass which delaminates shall be replaced at no charge (materials and labor) for a minimum five (5) year period beginning on date of manufacture.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel:
 - 1. Hot rolled shapes and plates shall conform to ASTM A 36.
 - 2. Tubing shall conform to ASTM A 500 or A 501.
 - 3. Stainless steel bars and sheet shall be AISI Type 302 or 304 and/or consistent with an FBC approved NOA (or FBC product approval) certification. Minimum thickness is: 0.062 inch for frames; 0.031 inch for trim covers; 0.012 inch for concealed flashing.
 - 4. Non tubular cold formed carbon steel with thickness 0.168 inch or less shall conform to ASTM A 653.
- B. Aluminum:
 - 1. Acceptable alloy and temper combinations for extrusions subject to fabrication, finish and structural requirements are: 6063-T5; 6063-T6; 6061-T6. Other

alloys of the 6xxx series and other tempers may be submitted for approval. Nominal wall thickness of 0.125 inch or greater is acceptable for structural extrusions; wall thickness less than 0.125 inch may be acceptable and is subject to approval. Minimum nominal wall thickness for nonstructural interior trim shall be 0.062 inch.

2. Acceptable alloy and temper combinations for sheet and plate subject to fabrication, finish and structural requirements are: 3003-H14; 5005-H14. Other alloys of the 3xxx, 5xxx and 6xxx series and other tempers may be submitted for approval. Minimum nominal thickness is 0.04 inch for flashings and 0.125 inch for all other applications.
- C. Glass:
1. For consistency of quality, appearance and performance throughout the work, glass materials shall be the product of a single manufacturer or fabricator for each kind or condition of product indicated, and shall be composed of primary glass from a single source.
 2. Glass shall conform, as a minimum, to the following standards.
 - a. Flat glass shall conform to ASTM C 1036, quality q3
 - b. Heat-treated flat glass shall conform to ASTM C 1048, except that surface compression of heat strengthened glass shall be 3500 to 8500 PSI.
 - c. Tempered and laminated glass shall conform to ANSI Z97.1.
 - d. Laminated glass shall conform to ASTM C 1172.
 3. Provide safety glass at the following locations.
 - a. Doors.
 - b. Fixed and operable glazing where nearest exposed edge of glazing is within a 24 inch arc of either vertical edge of the door in a closed position and where exposed bottom edge of glazing is less than 60 inches above walking surface.
 - c. Fixed glazing and operable glazing with exposed area exceeding 9 square feet, with exposed bottom edge less than 18 inches above a walking surface, exposed top edge more than 36 inches above walking surface, with a walking surface within 36 inches horizontally of glazing; Safety glass is not required if there is a protective bar with minimum 1.5 inch width located between 34 and 38 inches above walking surface on accessible side of glazing, with bar capable of supporting a horizontal load of 50 pounds per linear foot without contacting glass.
 - d. Additional locations required by code.

4. Provide heat strengthened glass where required by design pressures, anticipated thermal stress, or use in spandrel area. Provide fully tempered glass only where safety glass is mandatory or where design pressures exceed capacity of heat strengthened glass.
5. Glass Edge Quality:
 - a. Annealed Face Glass:
 - (1) Shark teeth shall not penetrate more than half of glass thickness.
 - (2) Serration hackle shall not penetrate more than 10 percent of glass thickness.
 - (3) Flare shall not exceed 0.062 inch as measured perpendicular to glass surface across edge.
 - (4) Bevel shall not exceed 0.062 inch.
 - (5) Flake chip depth shall not exceed 0.031inch and length or diameter shall not exceed 0.25 inch.
 - (6) Rough chips are not permitted. Rough chips are those which exceed dimensional limits for flake chips.
 - b. Heat treated face glass shall have seamed edges, free from shark teeth, serration hackle, flare and chips.
6. Laminated glass shall consist of two layers of heat strengthened glass of equal thickness and DuPont Butacite or Solutia Saflex interlayer of thickness required, but not less than 0.060 inch nominal thickness.
7. In addition to conforming to ASTM C 1048, heat treated glass shall conform to the following flatness tolerances.
 - a. Bow and warp are defined as deviation of a glass surface from a true plane, with glass free-standing or installed in a frame and positioned in a vertical plane.
 - b. Localized bow refers to any straight line segment on a glass surface with length of 12 inches.
 - c. Overall bow refers to any straight line segment on a glass surface which extends between opposite edges and is perpendicular to at least one edge. Length of line segment is gage length.
 - d. Localized bow shall not exceed 0.0625 inch.
 - e. Overall bow shall not exceed: 0.041 inch per foot for gage length zero to 36 inches; 0.031 inch per foot for gage length 36 to 60 inches; one half of

the values listed in ASTM C 1048, Table 2 for gage lengths exceeding 60 inches.

- f. Where heat treating results in parallel ripples or waves, maximum peak-to-valley deviation shall not exceed 0.005 inch. Requirements for localized bow and overall bow shall also be satisfied. Direction of ripples shall be consistent throughout building and shall be parallel to the glass width edge.
 - g. Specified bow and ripple tolerances are intended as manufacturing quality control limits and are subject to acceptance of the glass visual mockup, if provided
 - h. During the manufacture and the fabrication of glass for this project, heat treated glass shall be subjected to those quality control measures recommended by the glass manufacturer to identify and to minimize inclusions within the glass which could result in spontaneous breakage. Inclusions causing spontaneous breakage are defined as material defects by this specification. Heat treated glass which experiences spontaneous breakage after installation shall be replaced (material and labor) under the provisions of the warranty for this project.
8. Insulating glass shall have double edge seals. Primary seal shall be extruded polyisobutylene continuously bonded to glass surface and to dessicant filled metal spacer, including corners. Minimum width of the primary seal shall be 0.125 inches. Secondary seal shall be silicone (GE/GS 3725 or Dow Corning 982). Secondary seal shall completely cover spacer without gaps or voids and shall be continuously bonded to both plates of glass. The insulating glass units shall have been tested in accordance with ASTM E774, and compliance with classes C, B and A shall be indicated by a permanent label (visible after installation) with a minimum height of 0.05 inches. All muffins shall be aluminum and internal to insulated glazing units; refer to drawings for muffin locations and patterns.

D. Glazing System:

- 1. Window glazing system shall, at the option of the Contractor, be:
 - a. Option #1, a dense gasket against one face and a cellular gasket against the other glass face.
 - b. Option #2, a dense gasket against the interior glass face and a recessed compatible spacer with a continuous silicone cap seal against the exterior face.
- 2. At locations which are, by Code, subject to impact resistance criteria and testing, provide a continuous interior cap bead of silicone, or other method as may be approved, to assure the retention of glass within the framed opening.

3. All low "E" coatings shall adhere to glass surfaces in order to ensure that edge deletion does not occur for the life of the glass assembly.
 4. All glass will be manufactured and fabricated domestically, unless written approval is given by the Owner and the Architect as part of the preliminary product approval.
- E. Elastomeric Gaskets, Weatherstrips and Blocks:
1. Gaskets and weatherstrips:
 - a. Cellular gaskets shall be extruded black neoprene or EPDM with a hardness of 40 +/- 5 durometer Shore A and conforming to ASTM C509, flame propagation test not required. Design cellular gaskets to provide 20 to 35% compression.
 - b. Dense gaskets shall be black extrusions (neoprene, EPDM or silicone) with a Shore A hardness of 75 +/- 5 for hollow profiles and 60 +/- 5 for solid profiles, and conforming to ASTM C1115, Type C or to ASTM C 864.
 - c. Injection mold corners of all exterior gaskets unless shown to be incompatible with the installation procedures.
 - d. Gaskets shall be designed to produce glass edge pressure of 4 to 10 pounds per linear inch.
 - e. All gaskets shall be UV resistant.
 2. Silicone gaskets and sheet, where used to absorb movements at framing expansion joints, shall conform to ASTM C 1115, Type T
 3. Gaskets and weatherstrips shall have a continuous spline or a continuous groove engages a matching groove or leg on the aluminum frame
 4. Setting Blocks:
 - a. Setting blocks shall be dense extruded neoprene, silicone or EPDM with hardness of 85 +/- 5 durometer Shore A, minimum length of 4 inches and minimum width corresponding to glass thickness. Setting blocks shall be equidistant from glass centerline (location of setting blocks at quarter points is acceptable). Distance from vertical glass edge to nearest edge of setting block shall not be less than six inches (or 0.125 times glass width, whichever is greater). **PVC setting blocks will not be acceptable.**
 - b. Shims used in conjunction with setting blocks shall be of the same material, hardness, length and width as the blocks.
 - c. Setting blocks and chairs shall be secured against migration.

5. Side Blocks:
 - a. Provide side blocks at both jambs, between mid-height and top corner of glass. Blocks shall be 55 +/- durometer Shore A dense neoprene, silicone or EPDM. Block width shall be 0.125 inch less than nominal glass edge clearance.
 - b. Side blocks are not required where glass is continuously sealed with silicone at two or more edges

- F. Anchors in Concrete and Masonry:
 1. Anchors embedded in concrete and masonry shall be prime painted rolled steel, or hot dip galvanized cold formed steel.
 2. Strength of embedded anchors shall be developed by integral projections, welded deformed bars, or headed studs.
 3. At masonry, through bolts are acceptable provided that bearing plates are used at both masonry surfaces. Expansion bolts are acceptable provided they are designed for use in masonry.
 4. Expansion bolts are acceptable at concrete.
 5. Self drilling, self threading screws are not acceptable. Screws in plugs and powder actuated fasteners are not acceptable.

- G. Fasteners:
 1. Fastener requirements are applicable to screws, bolts, nuts, washers, rivets and pins.
 2. Fasteners shall comply with FBC approved NOA certification and cut-sheets or documentation shall be provided to Architect.
 3. Stainless steel fasteners (alloy type 302 or 304 only), or aluminum fasteners if acceptable to manufacturer, are required at the following locations, and are acceptable at all locations:
 - a. Locations with exposure to outdoor air
 - b. Joinery of aluminum frames, regardless of exposure
 - c. Glazing pockets
 - d. Internal cavities that act as gutters, or that may potentially contain water resulting from leakage or condensation
 4. Carbon steel fasteners with zinc plating or cadmium plating are acceptable at other locations; with silicone sealant encapsulation at locations where fasteners

will be subject to corrosion if primary sealant joint fails, and when approved in writing by the Architect and the Owner.

5. Provide lock washer or other locking device at all bolted connections.
6. Powder actuated fasteners are not acceptable.

H. Shims:

1. At connections subject to movement, separate moving surfaces with friction reducing pads. Pads shall have minimum 0.062 inch thickness, shall sufficiently reduce friction to permit movement, shall be resistant to wear, and shall be positively retained in position (open ended slots are not acceptable). Pads shall not be subjected to heat damage from welding or cutting, or to excessive pressure from overtightening of bolts.
2. Shims which transfer shear forces (tending to slide one shim against another) shall be steel plates, set in a staggered pattern and fillet welded to each other and to adjacent steel surfaces. Shims and welds shall be structurally designed to support applied loads.
3. Plastic shims are acceptable at static connections for which shims transfer only compressive forces.
4. Wood shims are not acceptable.

I. Weep hole filters shall be 20 to 45 pore per inch PVC coated open cell urethane foam.

J. Sealants:

1. Acceptable products (subject to tests) for seals to substrates other than stone are: Dow Corning 790, 795 and 995. A primary and secondary perimeter seal shall be provided at the jamb, head end sill of framed assemblies abutting masonry or concrete surfaces.
2. Data sheets for and samples of other sealants may be submitted for approval. Oil base sealants are not acceptable.
3. Sealant back-up materials shall be closed cell, non-gassing and non-absorptive. Acceptable materials include: polyethylene foam, urethane foam or extruded silicone as recommended by sealant manufacturer. Back-up shall not absorb water.
4. Coordinate with other sections to assure compatibility of intersecting sealants, and that porous or stone materials shall not be stained.

K. Primers:

1. Coat aluminum surfaces in contact with masonry, concrete or unpainted steel with prime paint (non-wetted only) or bituminous paint (wetted areas) where required.
 2. Prime paint steel parts of anchors, embedded anchors, exposed reinforcement and supports. After field welding, remove weld slag and touch up primed surface.
 3. Provide minimum dry film thickness of one mil for paint and 30 mils for bituminous paint. Prime paint shall conform to GSA specification TT-P-645. Bituminous paint shall conform to SSPC-Paint 12.
- L. Product Source:
1. Solely for the purpose of designating type and quality for the work described in this section, drawing details and specifications are based upon the products of YKK AP America or approved equal. Upon written request and submission of preliminary submittal requirements, alternate products will be reviewed for acceptance by the Architect.
 2. For consistency of quality, appearance and performance throughout the work on window walls, windows, and operating hardware shall be the product of a single manufacturer or fabricator for each kind or condition of product indicated.
- M. Window Wall Framing:
1. Where required to comply with structural design criteria, aluminum framing shall be YKK AP 50FI Impact Resistant Storefront System with insulated glass or approved equal, including product(s) by Sun Metal Systems, PGT, Inc., EFCO Corporation; a Pella Company, fitted to receive glass types shown and specified. It shall be adapted to the adjacent building construction and shall be anchored and reinforced as required to withstand specified impact and design wind loads.
 2. Segmented aluminum framing shall be YKK AP America YHS 50 FI or approved equal, including product(s) by Sun Metal Systems, PGT, Inc., EFCO Corporation; a Pella Company, or YKK AP America, modified to suit hardware and glazing conditions shown and shall be provided with full length spliced and sealed flashed sill, installed and sealed water-tight to the adjacent building structure prior to the installation of framing and glazing work and shall be anchored and reinforced as required to withstand specified design wind loads. All Fixed systems shall have FPA/NOA extruded sill pan.
- N. Windows: Fixed windows shall be YKK AP America 50 FI (non-thermal) or approved equal, including product(s) by PGT, Inc., EFCO Corporation; a Pella Company.

1. Comply with Glazing System requirements
 2. Required test specimen size is largest size for this project, not the size required by AAMA/NWDA 101/1.S.2.
 3. Locks and strikes shall be type 302 or 304 stainless steel or white bronze. Provide, at a minimum, cam locks with handles and strikes per vent, in compliance with NOA certification and FBC approvals.
 4. Vent frames shall be extruded tubular aluminum not less than 2 inches in depth. Tube perimeter shall be continuous aluminum and shall not be interrupted by a thermal break.
 5. Weather strips shall have a continuous spline engaged in a continuous groove in the frame.
 6. Balance arms shall be four-bar stainless steel type 302 or 304 with adjustable friction shoe. Provide two balance arms per vent.
 7. Provide two limit stops per vent. Material shall be 302 or 304 stainless steel. Stops shall restrict clear opening to four inches and shall provide for deactivation by the Building Custodian to allow screen removal/installation
- O. Entrance Doors: Glazed entrance doors for manual-swing operation shall be YKK AP American 50H Entrances or approved equal, including products by PGT, Inc., EFCO Corporation; a Pella Company.
1. Door Construction: Monumental; 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: As indicated Wide stile; 5-inch nominal width.
 - a. Bottom Rail with weatherstrip; 10-inch nominal height.
 - b. Accessible Doors: Smooth surface for width of door in area within 10 inches above floor or ground plane.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- P. Entrance Door Hardware:
1. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 - a. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated.

- b. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - c. Opening-Force Requirements:
 - 1) Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - 2) Accessible Interior Doors: Not more than 5 lbf to fully open door.
 - 2. Opening-Force Requirements:
 - a. Latches and Exit Devices: Not more than 15 lbf required to release latch.
 - 3. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305, as specified in Division 8 Section "Door Hardware."
 - 4. Cylinders: As specified in Division 8 Section "Door Hardware."
 - 5. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing. Electric Access controls with CVR's shall be provided at doors scheduled to be "secured" or electrically access controlled.
 - 6. Weather Stripping: Manufacturer's standard replaceable components.
 - a. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 7. Silencers: BHMA A 156.16, Grade 1.
- Q. Accessory Materials:
- 1. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 "Caulking and Sealants."
 - 2. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.
- R. Concealed Flashing:
- 1. Acceptable materials are neoprene or silicone (type "T" only) sheet, stainless steel sheet and mill finish aluminum sheet. Minimum thickness for flashing is 0.062 inch for neoprene or silicone, 0.012 inch for stainless steel, and 0.040 inch for aluminum. Aluminum, where in contact with dissimilar materials, is required to have a bituminous coating.
 - 2. Provide sealed interior glass stops, flashing adapters, and gutters with sealed lap joints, end dams and transitions or fully welded joints where required to assure control and drainage of infiltration to gutters.

2.2 FABRICATION

- A. As far as practicable, fabrication, glazing and assembly shall be completed in the shop.
- B. Exposed work shall be carefully matched to produce continuity of line and design. Joints in exposed work, unless otherwise shown or specified, shall be accurately fitted and rigidly secured. Remove burrs from cut edges. Ease corners and edges.
- C. Except where otherwise shown, specified or directed, method of assembly and joining shall be at manufacturer's discretion as shown on the approved shop drawings.
- D. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and by methods recommended by suppliers of alloys being welded. Welds behind finished surfaces shall be done as to minimize distortion and/or discoloration on finished side. Weld spatter and welding oxides on finished surfaces shall be removed by descaling and/or grinding.
- E. Unless otherwise shown or specified, weld beads on exposed surfaces shall be ground and finished to match and blend with finish on adjacent metal. Grinding and polishing of nonferrous metal shall be done only with clean wheels and compounds free from iron and iron compounds. Soldering and/or brazing are not acceptable.
- F. Provide exposed fasteners only where shown on approved shop drawings. Exposed fasteners shall be countersunk. Fastener heads shall be finished to match fastened material and shall be sealed or gasketed as required to prevent water entry.
- G. Provide specified finishes on exposed surfaces. Provide specified galvanized finish on all concealed carbon steel parts or reinforcements potentially exposed to water infiltration.
- H. Sealant work performed in the shop shall be done in strict conformance with the sealant manufacturer's written instructions. Excess sealant in visible areas shall be cleaned off immediately upon completion of assembly work and prior to shipment.
- I. Aluminum-Framed Entrances:
 - 1. Form or extrude aluminum shapes before finishing.
 - 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld splatter and welding oxides from exposed surfaces by descaling or grinding.
 - 3. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the systems to exterior.
 - d. Physical and thermal isolation of glazing from framing members.
 - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

- f. Provisions for field replacement of glazing.
 - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
4. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
5. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
6. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.
7. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - a. At exterior doors, provide compression weather stripping at fixed stops.
 - b. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
8. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - a. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - b. At exterior doors, provide weather sweeps applied to door bottoms.
9. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
10. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.3 TOLERANCES

- A. Tolerances in current edition of Aluminum Association "Aluminum Standards and Data" are applicable to finished, fabricated and assembled materials, except that flatness tolerance for aluminum sheet panels shall be half of standard sheet tolerance. Maintain stricter tolerances where required for proper fit of components.

2.4 ALUMINUM FINISH

- A. General Requirements:
 1. Exposed aluminum surfaces shall be finished with a factory oven cured finish. Paint shall be supplied by a licensed formulator.
 2. Application of finish shall be performed under specifications issued by licensed formulator, by an applicator specifically approved by formulator.

3. Color shall be custom color to be anodized aluminum or "Bone White or" for frames and sun shades to match Owner's sample. Samples submitted for approval shall show extremes of color range.
 3. Pretreatment of metal surfaces shall be done in accordance with procedures recommended by formulator.
 5. Field touch-up of painted aluminum is permitted only with written permission from the Architect. Unless such touch-up is authorized, replace damaged material with new material.
- B. Outdoor Surfaces:
1. Painted aluminum finish shall be an electrostatically applied high performance powder coating complying with AAMA 2605 and based on PPG's "Kynar" coating system or approved equal.
 2. Pigmented organic coatings for extrusions, structural shapes, sheet or plate, spray applied in the factory, shall meet requirements of AAMA 2605.
 3. Exterior exposed aluminum surfaces shall be finished with a factory oven cured three coat (minimum) finish based on Kynar 500 or Hylar 5000 fluoropolymer resin. Formulation shall have at least 70% Kynar 500 or Hylar 5000 resin in residual solids.
 4. Pigmented organic coatings for extrusions, structural shapes, sheet or plate, spray applied in the factory, shall meet the requirements of AAMA 2605 for basis of design Kynar coating system.
 5. Warranty:
 - a. Color changes shall not exceed 5E NBS units as defined by ASTM D 2244 for the specified special warranty period.
 - b. Chalking shall not exceed a number 8 rating as defined by ASTM D 4214.
 - c. Paint film shall not crack or peel during the specified special warranty period.
 - d. Coating manufacture shall provide written certification that the applicator is approved in order to provide a ten (10) year warranty for the coating.
 - e. Anodized Finishing shall be a minimum of AAMA 612, meeting warranty of 10 years
 6. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:
 - a. of AAMA 612. Aluminum extrusions shall be produced from quality controlled billets meeting AA-6063-T5.
 - b. Exposed Surfaces shall be free of scratches and other serious blemishes.
 - c. The anodized coating shall comply with all of the requirements of AAM 612: Voluntary Specifications, mortar, salt spray, and chemicals

commonly found on construction sites, and to resist the loss of color and gloss.

- d. Overall coating thickness for finishes shall be a minimum of 0.7 mils.

C. Indoor Surfaces:

1. Specified finish for outdoor surfaces is acceptable for indoor surfaces.
2. Where outdoor and indoor parts can be finished separately, factory oven cured acrylic or polyester paint is acceptable for indoor surfaces.
3. Acrylic and polyester pigmented organic coatings for extrusions, structural shapes, sheet or plate, spray applied in the factory, shall meet requirements of AAMA 2604.

2.5 STEEL FINISHES

- A. Cold formed carbon steel with thickness 0.168 inch or less shall be hot dip galvanized to meet or exceed requirements of classification G 90 of ASTM A 653.
- B. Cold formed carbon steel with thickness exceeding 0.168 inch and hot rolled steel shall be prime painted in accordance with GSA specification TT-P-645 or hot dip galvanized in conformance with ASTM A 123
- C. Concealed carbon steel reinforcement potential exposed to water infiltration shall receive hot dip galvanized finish in conformance with ASTM A123.
- D. After fabrication of painted steel, all cut ends and holes shall be degreased and prime painted. Galvanized finish shall be applied after fabrication.

2.6 SOURCE QUALITY CONTROL

- A. Adhesion, Compatibility and Stain Tests
 1. Provide to sealant manufacturers samples of all substrates which are in contact with sealant, regardless of whether adhesion must be achieved.
 2. For substrates which must support adhesion, submit for record only sealant manufacturers' reports of adhesion tests conducted in accordance with ASTM C 794. Metal screen is an acceptable substitute for airplane cloth.
 3. For substrates which are in contact with sealant, submit for record only sealant manufacturers' reports of compatibility tests for sealants and primers conducted in accordance with ASTM C 1087.
- B. Inspect materials and workmanship to assure compliance with Contract Documents. Provide access to storage and manufacturing facilities for observation by Owner and Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, prior to start of work, that structure and site conditions are ready to receive work of this section. Establish offset lines and bench marks as required for this purpose and for installation.
 - 1. Verify location, alignment and position of embed anchors installed by others.
 - 2. Verify that concrete openings into which work by this contractor is to be installed are level, square and sized to allow this work to proceed in accordance with the approved drawings installation tolerances specified herein.
 - 3. Notify the General Contractor in writing of any openings which do not comply with requirements specified below.

3.2 INSTALLATION

- A. Install materials in accordance with approved drawings. Provide labor, material, equipment and supervision necessary for complete installation.
 - 1. Glass installation shall comply with GANA (Glass Association of North America) "Glazing Manual" except as specifically recommended otherwise by the glass manufacturer.
 - 2. All framing joints shall be accurately and securely fitted and properly sealed for a weather-tight installation. All cut and machined ends and recesses shall be true, accurate and free of burrs and rough edges.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Caulking and Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Tolerances:
 - 1. Provide anchor adjustment capability for full range of specified tolerances for building structure.

2. Work of this section shall be within the following tolerances.
 - a. Deviation from plumb, level or dimensioned angle shall not exceed 0.125 inch per 12 feet of length of any member, 0.25 inch in any total run in any line.
 - b. Deviation from theoretical position in plan or elevation, including deviation from plumb, level or dimensioned angle, shall not exceed 0.375 inch total at any location. Change in deviation shall not exceed 0.125 inch for any 12 foot run in any direction.
 - c. Maximum offset from true alignment between two consecutive members placed end to end shall not exceed 0.062 inch.
 - d. Maximum offset between glass framing members at corners of glazing pocket shall not exceed 0.031 inch.
- G. Anchorage:
1. Anchor component parts by bolting and welding. Install slip pads between moving parts in accordance with FBC - NOA certification or manufacture's requirements.
 2. Provide non-corrosive separators between dissimilar materials.
 3. Perform field welding in accordance with AWS standards. Prepare surfaces as specified for shop welding. Remove weld slag and apply prime paint over welds. Prime paint exposed portions of embedded anchors. Touch up shop applied primer that is damaged by welding or other causes. Do not perform welding where discoloration or other damage would result on exposed surfaces, including glass and finished metal.
 4. Where slots or oversize holes are provided for adjustment only, secure connection after final adjustment. Interlocking serrations in extruded aluminum brackets and washers are acceptable. Steel weld washers with 0.25 inch minimum thickness are acceptable with steel brackets. Special washers or nuts which rely on friction and/or surface indentation of fastened part are not acceptable.
- H. Internal Gutters and Drainage:
1. Seal water and air tight all interior joints between window framing members and glazing adapters or removable glass stops, in accordance with FBC - NOA (or FBC product approval) certification or manufacture's requirements.
 2. Provide and install flashed sill gutters at all window walls and at windows where shown or where required by specification, or compliance with FBC - NOA (or FBC product approval) certification or manufacture's requirements. Sill gutters shall be installed with integral end dams at each jamb.

3. Flashed gutters shall be continuous for the full length of each building structure opening and fitted with permanently sealed splice joints where required. Gutter shall slope to drain to exterior and shall be closed at ends with metal closures shop welded or mechanically attached and sealed to the gutter assembly, in accordance with FBC - NOA (or FBC Product Approval) certification or manufacture's requirements.
 4. End closures for the flashed sill gutters shall be fully weather sealed (front to back depth of gutter) to adjacent building structure. Weather seal shall direct all infiltration, including drainage from adjacent building elements, into the flashed sill gutter for drainage to the exterior, in accordance with FBC - NOA (or FBC product approval) certification or manufacture's requirements.
 5. Remove any temporary shims and fasteners, leaving all moving joints free to accommodate building movements as designed.
- I. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points:
 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturer's written instructions using concealed fasteners to greatest extent possible.
 - J. Install perimeter joint sealants as specified in Division 7 Section "Caulking and Sealants" to produce weathertight installation.
 - K. Clean surfaces to be sealed. Install backers, primers and sealant in accordance with drawings, test results and manufacturer recommendations. Tool sealants as a separate operation after application. Immediately remove masking.

3.3 GLAZING

- A. Inspect frame for proper dimensions, square, freedom from obstructions within glass pockets, and proper joinery seals and drainage provisions. Adjust frame and/or glass size as required to meet specified requirements.
- B. Clean glazing pocket before setting glass. Solvents shall be compatible with finished aluminum, glass and glazing materials. Setting blocks shall be provided at all lights, including doors, and shall be equidistant from glass centerline. Location of setting blocks at glass quarter points is acceptable. Distance from vertical glass edge to nearest edge of setting block shall not be less than six inches, or 0.125 times glass width, whichever is greater. Side blocks shall be located between mid-height and top corner of glass. Side blocks, setting blocks and chairs shall be positively retained in position.
- C. Install gaskets with injection molded corners on exterior (and interior where practicable). Where gasket corners cannot be molded, provide excess gasket lengths as required for "crowd in" of gasket to assure permanently tight corners.

Tightly butt ends of gaskets and seal all non-molded gasket corners with compatible sealant. Gasket joints shall not occur at locations other than corners.

- D. Inspect glass before installation. Glass not conforming to specification shall not be installed. Replace any glass lights broken or damaged on face or edge surfaces.
- E. Except as otherwise specified, comply with GANA Glazing Manual. Provide minimum nominal glass bite of 0.5 inch. Where designed joint movement will result in variable glass bite, increase nominal bite to provide not less than 0.375 inch bite and not less than 0.25 inch minimum edge clearance under full range of specified movements.
- F. Remove and replace stops and apply sealants at joints as required for complete and water/air tight glass installation.
- G. Coordinate sequencing of glazing with General Contractor and defer glazing of openings obstructed during construction. Glaze such openings when obstructions are removed.

3.4 FIELD QUALITY CONTROL

- A. Field Check for Water Leakage:
 - 1. Method for field check for water leakage shall be by "static pressure" box test (modified AAMA 502) at a pressure of 8 PSF. There shall be no unacceptable water leakage as defined herein. Refer to procedures outlined below for specific testing criteria.
 - 2. The water leakage field check and sealant adhesion tests shall be monitored by an independent testing agency approved by the Architect and Owner.
 - 3. Provide powered scaffold, hose, water supply, test enclosure, instrumentation and manpower to perform at least two successful groups of tests, plus repeat of any unsuccessful tests. The test areas shall be selected by the Architect and shall be completely representative of the intended construction, including all operating hardware, locks, handles, perimeter sealants, and surrounding construction.
 - 4. Initial water testing shall be conducted within 1 week of start of glazing. Construction sequence shall be accelerated, where necessary, to allow for timely completion of any surrounding areas affecting the conducting of this initial test. General Contractor and Glazing Subcontractor shall advise Architect, approved testing agency, Owner, and glazing consultant in writing when installation testing shall be conducted only when a floor area of the building is completed and ready to be tested, test area shall be randomly selected from the completed work area. Scheduling of the testing shall be conducted so as to not to delay construction and within an adequate time to identify any problem area with window wall installation.

5. Remedial measures, if required as a result of these tests, shall be subject to approval prior to installation, shall be applied to all previously installed work and shall maintain the standards of quality and durability for the project. A third group of tests may be required if, in the opinion of the Architect, necessary to verify the maintenance of quality. Costs of all such tests, and remedial action (if necessary) are the responsibility of the contractor.
- B. Field test for sealant adhesion: Periodically test sealants in place for adhesion, using methods recommended by sealant manufacturer. Promptly replace any sealant failing to adhere or to cure.
- C. Field test for wall drainage gutter:
1. Where applicable, test the internal gutters on the initial two floors by temporarily plugging the weeps and filling the gutters with water to a depth of about 2 inches. After not less than 15 minutes, inspect the gutters for leakage.
 2. Correct any deficiencies observed and retest until successful tests are achieved. If deficiencies occur, continue testing 100% of the gutters until at least one complete floor has been tested without failure.
 3. Continue testing at the rate of not less than 10% of all gutters, randomly selected. If deficiencies recur, resume test program as described.
- D. Field test performance criteria for assembly:
1. The Contractor and window manufacturer and/or installer shall complete the work and prepare an area of the building to be tested, which shall be a minimum of one floor level representative of the project conditions. Testing will not be conducted without written notification in accordance with Part 3 of this specification that the test area is ready for field testing from the Contractor.
 2. Test Sequence:
 - a. Water infiltration under static pressure (10 PSF).
 3. Condensation is acceptable during water infiltration tests. Water leakage is acceptable only if all of the following conditions are satisfied: (a) water is contained and drained to exterior; (b) there is no wetting of a surface that would be visible to building occupants; (c) there would be no staining or other damage to completed building or its furnishings. This definition of water leakage governs over any other definition appearing in referenced documents.
 4. Where test sequence or test failure requires successive water infiltration tests, the only means used to drain water from internal cavities shall be gravity drainage through weep system for a minimum of 15 minutes. Air pressure, removal of parts or other means of draining water shall not be used.
 5. Static water infiltration test shall conform to ASTM E 331. Differential test pressure shall be 10 PSF. There shall be no unacceptable water leakage as defined herein. Sources of water leakage shall be identified.

3.5 ADJUSTMENT

- A. Adjust operating components for proper fit within fixed frame.
- B. Adjust weather-strips for continuous contact and seal in closed position.
- C. Adjust hardware for proper operation.
- D. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

3.6 MAINTENANCE - REPLACEMENT

- A. Provide Owner glazing details applicable to replacement glass, with outline of procedure for glass replacement.

3.7 PROTECTION AND CLEANING

- A. Protect materials against damage and contamination. Maintain installed work in reasonably clean condition and clean surfaces as required to remove dirt, stains and corrosive substances, during and at conclusion of construction.
- B. Periodically remove from the site debris, excess materials and unused tools and equipment resulting from this work. At conclusion of construction, leave premises in clean condition.

END OF SECTION 08905

SECTION 09260 – GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Gypsum board panels for ceilings and soffits.
 - 3. Tile backing panels.
 - 4. Non-load-bearing steel framing.
- B. Related Requirements:
 - 1. Division 5 Section “Structural Metal Studs” for heavy gauge metal stud framing at load bearing and exterior walls.
 - 2. Division 7 Section “Caulking and Sealants” and “Fire Resistive Joint Systems.”

1.3 REFERENCES

- A. ASTM C36 – Standard Specification for Gypsum Wallboard.
- B. ASTM C79 – Standard Specification for Gypsum Sheathing Board.
- C. ASTM C442 – Standard Specification for Gypsum Backing Board and Coreboard.
- D. ASTM C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- E. ASTM C630 – Standard Specification for Water-Resistant Gypsum Backing Board.
- F. ASTM C645 – Standard Specification for Non-Load (Axial) bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- G. ASTM C754 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- H. ASTM C840 – Standard Specification for Application and Finishing of Gypsum Board.

- I. ASTM C1002 – Standard Specification for Steel Drill Screws for the Application of Gypsum board or Metal Plaster Bases.
- J. ASTM E90 – Standard Test Method for Laboratory measurement of Airbourne-Sound Transmission Loss of Building Partitions.
- K. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
- L. GA-201 – Using Gypsum Board for Walls and Ceilings.
- M. GA-214 – Recommended Specification: levels of Gypsum Board Finish.
- N. GA-216 – Recommended Specification for the Application and Finishing of Gypsum Board.
- O. GA-600 – Fire Resistance Design Manual.
- P. UL – Fire Resistance Design Manual.
- Q. WH (Warnock Hershey) – Certification Listings.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design non-load-bearing steel framing, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Florida, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each textured finish indicated and on same backing indicated for Work.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed structural design of framing, and sealed by the qualified professional engineer, licensed in the State of Florida, responsible for their preparation.
 - 1. Submit shop drawings showing complete information for fabrication and installation of furred / suspended ceiling area framing. Indicate dimensions, location, size, spacing and gauge.
 - 2. Provide installation layout.
 - 3. Provide location and details of anchorage devices to be embedded in other construction.
- D. Submit a manufacturer's certificate that materials meet specification and project requirements.

1.6 QUALITY ASSURANCE

- A. Qualification Data: For qualified professional engineer.
- B. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- D. This subcontractor shall have been engaged with the installation of gypsum wallboard work and performed this work on at least three (3) projects equal in scope to this work. Submit data in writing showing compliance with these requirements to the Architect before starting of any work. See Section 00950 – Quality Assurance.
- E. Gypsum Board Finish – Level 5 finish at all public areas per GA-214. The surface shall be uniform light skip trowel. Any horizontal or vertical GWB area scheduled to receive wall covering or a faux finish is to receive a level 4 finish, unless noted or scheduled otherwise.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Sections 01600 and 01620.
- B. Deliver all materials in their original unopened containers with manufacturer's label intact and legible.
- C. Store materials per manufacturer's instructions.

1.8 SAMPLE PANELS

- A. Provide on-site erected samples each of the following:
 - 1. Vertical taped joints.
 - 2. Horizontal taped joints.
 - 3. Inside corner.
 - 4. Outside corner.
- B. Obtain Owner's and Architect's acceptance of visual qualities of the sample panels before start of the gypsum wallboard work. Retain sample panels during construction as a standard for judging completed wallboard work. Do not alter, move, or destroy sample panels until wallboard work is complete.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 2. Refer to Section 01600 materials and Equipment for product substitution requirements and approvals.

2.2 INTERIOR STEEL FRAMING

- A. Steel Framing, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Metal complying with ASTM C 645 requirements.
 - a. Protective Coating:
 - 1) Interior Applications: ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
 - 2) Exterior Applications: ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating
 2. Light gauge steel framing: Unimast Corp., Dietrich Industries, Inc., Dale/Incor Industries of Florida, or approved equivalent.
 3. Refer to specification Section 05410 for exterior and heavy gauge structural framing.
- B. Suspended Ceiling and Soffit Framing:
1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
 2. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 3. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch-wide flange, and 1-1/2" in depth.
 4. Furring Channels (Furring Members):
 - a. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange, 3/4 inch deep.
 - b. Steel Studs: ASTM C 645, in depth indicated.
 - 1) Minimum Base Metal Thickness: 0.0179 inch.

- c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - 1) Minimum Base Metal Thickness: 0.0179 inch.

C. Partition and Soffit Framing:

- 1. Steel Studs and Runners: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness: 0.0179 inch.0312 inch.
- 2. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- 3. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, and in depth indicated.
 - a. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.
- 4. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and 2 inches deep.
- 5. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 PANEL PRODUCTS

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than (75%) seventy five percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- C. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Gypsum.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. Lafarge North America Inc.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
 - 6. Certainteed.
- E. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Type X: 5/8 inch and with long edges tapered.

- F. Sag-Resistant Gypsum Wallboard: ASTM C 1396/C 1396M, manufactured to have more sag resistance than regular-type gypsum board, 5/8 inch thick, and with long edges tapered. Apply on ceiling surfaces.
- G. Water/Moisture Resistance Gypsum Board:
 - 1. Core: Mold and moisture resistant gypsum core.
 - 2. Surface Paper: Mold and moisture resistant paper on front, back, and along edges.
 - 3. Long Edges – Tapered.
 - 4. Overall Thickness – 5/8 inches.
 - 5. Panel to comply with requirements of ASTM C1396.
 - 6. Mold/Mildew Resistance: Score of 10 when tested in accordance with ASTM D3273.
- H. Tile Backing Panels:
 - 1. Cementitious Backer Units: Durock Board (Cement Board) complying with ANSI A118.9.
 - 2. Size and Thickness: 5/8 inch.
 - 3. Corrosion resistant fasteners.
 - 4. Joint reinforcement: 2 inch wide Imperta Glass – fiber; open weave tape, Type P
 - 5. Accessories: manufacturer’s standard.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. Expansion (Control) Joint: Use where indicated or where unbroken panel lengths exceed 30 feet.
- B. Aluminum Trim: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 METAL FRAMING

- A. Studs shall be screw type, roll-formed channel studs and tracks, of sizes shown on Drawings, fabricated from 25 gauge steel unless otherwise shown or specified, with stud flanges not less than 1-1/4 inch wide, of galvanized steel. Provide 20 gauge bottom track, typical.
- B. At all hollow metal doorframes, cased openings, and end of walls, provide one 20 gauge metal stud. Headers up to 4'-0" wide shall be made of same. Headers from 4'-1" to 6'-0" shall be two 3-5/8 inch 20 gauge metal studs on edge. Headers 6'-1" to 8'-0" shall be two 6 inch 20 gauge metal studs on edge.
- C. Studs shall meet or exceed ASTM C645 requirements with a minimum thickness of 0.0179 inch.
- D. Use 20 gauge metal furring or metal studs at all locations scheduled to receive Durcok Board as shown/scheduled. Also, frame all outside corners using 20 gauge metal studs.
- E. C. R. channel stiffeners formed of 16 gauge galvanized steel shall be installed in 25 gauge stud walls above the manufacturers specified limiting heights (10'-0" or higher).
- F. RC-1 resilient channels of corrosion-resistant steel, fastened to framing per manufacturer's recommendations.

2.7 DROPPED/FURRED DOWN CEILINGS

- A. Shall be Steel Stud Furring and Steel Stud framing systems made up of 6 inches, 4 inches, 3-5/8 inches, 2-1/2 inches, and 1-5/8 inch vertical and horizontal framing or hangers. Design loads per Table for Typical Limiting Spans – Steel Stud Ceiling Systems, Deflections are not to exceed L/360.

2.8 DRYWALL SOFFITS

- A. Braced soffit assembly consists of galvanized steel channel runners and studs faced with gypsum board, screw attached.
- B. Maximum depth of 48 inches (vertically) and widths to 72 inches (horizontally) per requirements of Maximum Width and depth Dimensions Table of USG Systems Folder SA-923.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Available Products:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
- E. Fire Stopping / Penetration Seals
 - 1. Refer to Section 07844 Fire resistive Joint Systems for rated assemblies and additional requirements.

PART 3 - EXECUTION

3.1 METAL FRAMING INSTALLATION

- A. All items in this section shall be installed by experienced skilled mechanics in the best workmanlike manner and in this trade's best standard practice in strict accordance with manufacturer's printed specifications and installation recommendations.
- B. Height of Partitions: Refer to Drawings for termination height of all partitions.
- C. Install metal partitions system plumb, level and true. All joints, connections, etc. shall be fastened securely with proper fasteners as recommended by manufacturer's printed instructions. Fastening surface of any framing or furring shall not vary more than 1/8 inch from plane of faces of adjacent framing, bridging or furring members.
- D. Metal partitions shall be erected by aligning floor and ceiling track to ensure plumb partition. Secure track with suitable fasteners at a maximum of 24-inch o.c. provide continuous tracks sized to match studs.
- E. Provide fasteners at all corners and ends of runner tracks.
- F. Provide additional studs to support inside corners at partition intersections and corners and to support outside corners, terminations of partitions, both sides of control joints (if any) and adjacent to all openings. For gypsum plaster base applications, Keep studs not less than 2 inch or more than 6 inch from inside corners.
- G. Use full-length studs between runner tracks wherever possible. If necessary splice studs by nesting with a minimum lap of 8 inch and fasten laps with 2 screws through each flange.
- H. Friction fit studs to runner tracks by positioning and rotating into place. Provide positive attachment to runner tracks for all studs using 7/16 inch self-tapping screws or stud clinching tool on both flanges of studs.
- I. Provide rough framing at openings using full-length studs adjacent to jambs and horizontal header and sill tracks. Cut horizontal tracks to length, split flanges, bend webs at end of flange overlap, and screw attachment to jamb studs. Install cut to length, intermediate studs between jamb studs at head and sill sections at same spacing as full-length studs.
- J. Stiffen drywall partitions horizontally with 3/4 inch cold-rolled steel channel stiffeners. Install channels horizontally through stud knockouts at 4'-0" on center vertical spacing. Wire tie to each stud or secure as recommended by stud manufacturer. The 25 gauge metal stud walls, 16 inch o.c. up to and including the manufacturers specified limiting height, are not required to have C.R. channels unless required in specific areas due to extra loading requirements and/or fire rating requirements.
- K. At plumbing chase walls provide two 1/2 inch by 12 inch high by thickness of wall wallboard stiffeners as per manufacturer's printed instructions, or 6" minimum width 25 gauge metal studs.

- L. For extra heavy loads, shelf brackets, TV's, wall mounted furnishings, millwork, fixture brackets, handicap accessories, etc. provide proper supports as recommended by the manufacturer's printed instructions.

3.2 NON-LOAD-BEARING STEEL FRAMING INSTALLATION

- A. General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

- B. Suspended Ceiling and Soffit Framing:

1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Wire-tie furring channels to supports.

- C. Partition and Soffit Framing:

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

- D. Z-Furring Members: Erect insulation vertically and hold in place with Z-furring members.
 - 1. Until gypsum board is installed, hold insulation in place with 10-inch staples fabricated from 0.0625-inch- diameter, tie wire and inserted through slot in web of member.

3.3 PANEL PRODUCT INSTALLATION

- A. Gypsum Board: Comply with ASTM C 840 and GA-216.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
 - 2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
 - 3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 4. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 5. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 6. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 - 7. Laminating to Substrate: Comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
 - 8. Meet applicable requirements of governing authorities. Install to meet fire rating, STC requirements as indicated.
 - 9. Comply with applicable recommendations, requirements of "Specifications of Application, Finishing of Gypsum Wallboard"; GA-216 and ASTM C840.
 - 10. All gypsum wallboard to be sound, free of cracks, breaks, broken edges and corners. Precautions will be taken to prevent delamination and exposure to sunlight or ultra-violet radiation.
 - 11. Cut wallboard by scoring, breaking or sawing. Work from face side. Scribe wallboard to fit abutting surfaces.
 - 12. At radius walls, dampen both sides of wallboard; allow time for penetration of moisture to core before bending. Bend to give smooth, even curve on finish side.
 - 13. Cut openings for electrical outlets, fixtures, piping and other penetrations. Maintain close tolerances for accurate fit to allow for covering of edges with plates and escutcheons. Patch all penetrations at fire or sound walls with penetration seal – see Section 07900 for additional requirements.
 - 14. Apply wallboard to ceilings, horizontal surfaces, before applying to vertical surfaces.
 - 15. Stagger joints between gypsum base sheets on opposite side of partitions. Do not location vertical joints within 8 inches from corners of door frames and other openings.
 - 16. Use maximum practical length base sheets required to minimalize end joints and stagger end joints over studs.
 - 17. Butt joints loosely, maximum gap 1/4 inch. Sand edges that have been cut.

18. Wallboard surfaces, corners of columns, walls and partitions shall be accurately aligned, level, plumb, true to line without any deflection, bow or twist, ready to receive without adjustments subsequent interior finishes.
19. Provide fasteners of the type and size recommended by the gypsum plaster base manufacturer for the applications shown and specified. Set heads slightly below surface of base, but do not break paper face.
20. Fasten to metal studs or metal furring with self-tapping screws. Comply with manufacturer's instructions for fastening, but do not exceed 12 inch o.c. spacing for screws; except in vertical applications, space screws from edge joints not more than 9 inches o.c.
21. Joints: Apply joint compound and tape according to Gypsum Wallboard System used in strict accordance with manufacturer's written instructions.
22. Thickness: Wallboard thickness shall be as required and shown on Drawings to fulfill compliance with the total wallboard system and its intended use.

B. Tile Backing Panels (Cement Board):

1. Cementitious Backer Units: ANSI A108.11, at wet wall locations indicated to receive tile or as scheduled.

C. Moisture Resistant Gypsum Board:

1. Install Moisture Resistant Board at all wet walls whether or not scheduled or shown (adjacent to or within 8 feet of plumbing fixtures) not scheduled to receive tile. Tiles walls to receive cement board backer.

3.4 FINISHING

A. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. Aluminum Trim: Install in locations indicated on Drawings and where recommended in writing by ceiling suspension system manufacturer for trim for suspended ceilings.

B. Finishing Gypsum Board Panels: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Finish level as specified or scheduled.

1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas and concealed areas.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.

3. Level 3: Where panels are substrate for vinyl wallcovering (VWC) as recommended by VWC manufacturer.
4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
5. Level 5: A level 4 finish with an additional level of surface treatment, such as a thin skim coat of joint compound applied to the entire surface.

D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.5 PERIMETER CAULKING INSTALLTION

A. Caulk perimeter of indicated applications as follows:

1. At all sound insulated partitions provide continuous beads of sealant at juncture of both faces of runners or plates with floors, walls and ceiling construction and wherever gypsum wallboard abuts dissimilar materials.
2. At control joints provide continuous bead of sealant at faces of control joints. Caulk prior to installation of surface-applied control joint accessories and locate at proper depth in joint to allow for insertion of expansion portion of control joint accessory.
3. At openings and cutouts, fill open spaces between gypsum base and fixtures, cabinets, ducts and other flush or penetrating items, with continuous bead of sealant.
4. Caulk sides and backs of electrical boxes to completely seal openings and joints at sound insulated walls and fire rated walls.

3.6 SUSPENDED CEILINGS

- A. The Contractor shall furnish and install the suspended ceiling system in strict accordance with ASTM C636 and the manufacturer's printed instructions.
- B. The ceiling suspension system shall be leveled to within 1/8 inch in 12 feet prior to placing drywall and the deflection of any component shall not exceed 1/360 of span.
- C. The ceiling system shall be supported from the structure above the metal stud framing or No. 9 gauge hanger wire minimum. The supporting of wires from mechanical or electrical equipment, piping, ductwork or other equipment above ceiling SHALL NOT BE PERMITTED.
- D. Additional supports shall be provided for light fixtures, A/C grilles, panel access doors, etc.

3.7 CUTTING AND PATCHING

- A. Cut, patch, repair and point-up plaster as required and as directed by the Architect. Repair cracks and indented surfaces by moistening plaster and filling with new material, troweled or tamped flush with adjoining surfaces.

3.8 CLEANING AND PROTECTION

- A. All finish materials and finish surfaces must be protected from contact with veneer – other surfaces that have been stained, marred or otherwise damaged during the plastering work.
- B. When work is completed, remove unused materials, containers and equipment and clean floors of all debris and leave room broom clean. Installer shall advise Contractor of requirements for protecting the work from deterioration and damage until time of acceptance.

3.9 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at NO EXTRA COST to the Owner.

END OF SECTION 09260

SECTION 09310 – CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENT

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Porcelain floor and wall tile.
- B. Related Sections include the following:
 - 1. Division 9 Section “Gypsum Board Assemblies” for cement backerboards within drywall assemblies for all wall tile applications and ceramic wall boards porcelain panels.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Compatibility Certification: Provide certification of compatibility of sealer, grout and tile surfaces.
- C. Maintenance and cleaning information for care tile floor and sealer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Such products include, but are not limited to; porcelain tile, setting material, grout, sealant, noise transference products, transition strips, and expansion joint hardware.
- B. Shop drawings indicating tile patterns and locations of widths of expansion, contraction, control and isolation joints in tile substrates and finished tile surfaces.
- C. Submit list of all subcontractors that will be used on the specified project. Proof of Workman’s Compensation insurance must be provided for each subcontracted worker

- D. Samples: 2 Sets- 1 for Architect/Owner, 1 kept on site in a safe location through project completion.
 - 1. Each type, composition, color, and finish of tile, Schluter Schiene transition strips and Rondec tile cap and grout.
 - 2. Manufacturer's certifications and installation procedures.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 (Five) percent of amount installed, but not less than one box for each type, composition, color, pattern, and size indicated. Label boxes to indicate room location and application and mfg's contact information.

1.6 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) A137.1 American National Standard Specifications for Ceramic Tile.
- B. American National Standards Institute (ANSI) A108.1A - A108.13 American National Standard Specifications for the Installation of Ceramic Tile.
- C. American National Standards Institute (ANSI) A118.1 - A118.12 American National Standard Specifications for the Installation of Ceramic Tile.
- D. American National Standards Institute (ANSI) A136.1 American National Standard Specifications for the Installation of Ceramic Tile.

1.7 QUALITY ASSURANCE

- A. Tile Manufacturer: Company or Affiliate Company specializing in ceramic tile, trim units and/or thresholds. Obtain tile from a single source with resources to provide products of consistent quality in appearance and physical properties.
- B. Installation System Manufacturer: Company specializing in adhesives, mortars, grouts and/or other installation materials including ISO 9001 certification unless noted otherwise by Architect.
- C. Installer qualifications: company specializing in installation of ceramic tile, mosaics, with documented experience with similar installations of similar

scope, materials and design; or written certification and approval of the installers qualifications from the material supplier.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate installation of tile work with related work.
- B. Proceed with tile work only after curbs, vents, drains, piping, and other projections through substrate have been installed and when substrate construction and framing of openings have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles, where 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 as the Basis of Design..
 - 2. Product Source Reference: Mark Horton – Crossville Tile @ 1-941-809-1544.

2.2 TILE PRODUCTS

- A. Manufacturers: The Basis-of-Design shall be:
 - 1. As scheduled and shown on the drawings, or as selected by the Architect and the Owner. The pattern, size and material designations are shown on the drawings.
 - 2. Tile components shall include, but are not limited to, field tile, tile borders, wall tile, wainscot tile, tile base, accent tile and other elements shown on the drawings.
- B. Subject to compliance with requirements for matching the color match, texture, and tile specifications, manufacturers offering products that match the color samples and tile size scheduled, or that are approved as substitutions by the Architect and the Owner or Owner's designated representative may include the following manufacturers:
 - 1. Crossville, Inc.
 - 2. Daltile; Division of Dal-Tile International Inc.

- C. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
- D. Porcelain Floor Tile:
 - 1. Composition: Porcelain.
 - 2. Surface: >250, per ASTM C501, Matte and polished finishes.
 - 3. Module Size: Reference Drawings for module size No substitutions or changes to tile sizes will be authorized.
 - 4. Nominal Thickness: 3/8 inch nominal (MIN). unless otherwise defined Face: Factory Rectified For Flatness, Squareness and Consistent Thickness.
 - 5. Color and Pattern: As selected by the Architect and the from manufacturer's full range and to match the tile colors and finished shown in the drawings.
 - 6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.
 - a. Provide shapes and borders as shown on the Drawings and as, selected from manufacturer's standard shapes. All corners should be mitered.
 - 7. Tile Floor Base
 - a. At restrooms provide square edge module size same as adjoining floor tile with Schluter Rondec cap #80 trim continuous at all base tile; 1-Tile high tile base – (6 inches high), unless noted otherwise, color to match the adjoining floor tile scheduled & vertical edges or adjoining corners. Provide metal cove at the base of all tiled walls, with matching preformed corners and trim.

2.2 ACCESSORY MATERIALS

- A. Metal Trim: Schluter "Rondec" bullnose type profile with symmetrically rounded visible surface with 1/4" (6mm) radius, integrated trapezoid perforated anchoring leg, and integrated grout joint spacer. Finish to be Satin Nickel Anodized aluminum. Thickness to match tile thickness. Metal trim system shall include preformed inside and outside corners and concealed connectors at splice joints where trim cannot be run continuously. Schluter (Schiene" square corner type profile for tile base cap. Schluter "cove" for restroom & locker rooms tile wall & base intersection with wall tile. Provide preformed corners & joints for all metal trim.

2.3 SETTING AND GROUTING MATERIALS

- 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. Bostick
 2. C-Cure
 3. Custom Building Products
 4. DAP, Inc.
 5. Laticrete International, Inc.
 6. MAPEI Corporation
 7. Southern Grouts & Mortars, Inc.
 8. Summitville Tiles, Inc.
 9. TEC Specialty Products, Inc.
- B. Latex-Portland Cement Mortar (Thin Set Tile/Thick Set Bed): ANSI A118.4.
1. Prepackaged dry-mortar mix containing dry additive to which only water must be added.
 2. Prepackaged dry-mortar mix combined with liquid-latex additive.
 3. For wall applications, provide nonsagging mortar.
 4. Approved by the selected manufacturer for specific applications.
 - a. Available Products.
 - b. Modified non-sagging dry-set cement mortar for large and heavy tile thin-set applications complying with ANSI A118.4, A118.11 and ISO 13007 C2TES1P1: MAPEI "Ultraflex LFT" or Architect approval equal.
 5. Manufacturers standard cementitious setting bed at tile floors with a thick set setting bed.
- C. Standard Unsanded Cement Grout: ANSI A118.6, color selected by Architect.
1. Unsanded Grout: Unsanded polymer-modified Portland cement ceramic tile grout, complying with ANSI A118.6 and ISO 13007 CG2WA, for joints less than 1/8 inch (3 mm) wide; MAPEI "Keracolor U" or Architect approved equal.
- D. Polymer-Modified Tile Grout: ANSI A118.7, color as selected from manufacturers full range.
1. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.
 2. Sanded Grout: Fast-setting sanded polymer-modified grout, complying with ANSI A118.7 and ISP 13007 CG2WAF, for joints between 1/16 inch and 1 inch (1.5 mm and 25 mm) wide; MAPEI "Ultracolor Plus" or Architect approved equal.
- E. Epoxy Tile Adhesives: (Restroom floors & walls)
1. ANSI 118.3: Where indicated on the Drawings or where scheduled or specified for setting tile as specified by ANSI A108.6 Chemical Resistant, Water Cleanable tile setting and grouting epoxy over proper substrates. Kerpoxy by Mapai or Architect approved equal.

2.4 MISCELLANEOUS MATERIALS

- A. Elastomeric Sealants: Elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
 - 1. One-Part, Mildew-Resistant Silicone: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for in-service exposures of high humidity and extreme temperatures.
 - a. Available Products:
 - 1. Dow Corning Corporation; Dow Corning 795.
 - 2. GE Silicones; Sanitary 1700.
 - 3. Pecora Corporation: Pecora 898 Sanitary Silicone Sealant.
 - a. Grout Sealer: DuPont – “Stone Tech” professional grout sealer for ceramic and porcelain tile and grout, water based, low solids coating, clear sealer **No sealer shall be applied to the face of the tile, base or wainscot; sealer shall be applied to grout only at Public areas and factory applied sealer/finish is scheduled or specified.**

PART 3 - EXECUTION

3.1 SUBSTRATE EXAMINATION

- A. Verify that surfaces to be covered with ceramic tile, mosaics, pavers, brick, stone, trim or waterproofing are:
 - 1. Sound, rigid and conform to good design/engineering practices;
 - 2. With maximum deflection under all live, dead and impact loads, including concentrated loads, of L/360 for ceramic tile, mosaics, pavers or brick;
 - 3. Clean and free of dust, dirt, oil, grease, sealers, curing compounds, laitance, efflorescence, form oil or loose plaster, paint and scale;
 - 4. Level and true to within ¼” in 10’, and not more than 1/16” in 1” Variation from substrate high points, for applications by the thin bed method over substrate, thin waterproof membrane or thick crack isolation membrane;
 - 5. Not leveled with gypsum or asphalt based compounds;
 - 6. Dry as per American Society for Testing and Materials (ASTM) D4263 **“Standard Test for Determining Moisture in Concrete by the Plastic Sheet Method.”**
- B. Concrete surfaces shall also be:
 - 1. Cured a minimum of 28 days at 70°F, including an initial (7) day period of wet curing;
 - 2. Wood float finished, or better, if the installation is to be done by the thin bed method;
 - 3. Advise General Contractor and Architect of any surface or

substrate conditions requiring correction before tile work commences

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions.
- C. Remove protrusions, bumps, and ridges by sanding or grinding.
- D. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.
- E. Feathering: Where tile meets carpet, feather the tile up to and flush with the carpet, no transition strips will be accepted between carpet and new tile. For thresholds, all threshold locations must be approved prior to installation. Anchor guards to substrate.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation" latest edition. Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Cut and fit ceramic tile, brick or stone neatly around corners, fittings, and obstructions. Perimeter pieces to be minimum half tile, brick or stone. Chipped, cracked, split pieces and edges are not acceptable. Make joints even, straight, plumb and of uniform width to tolerance $\pm 1/16"$ over 8'. Install divider strips at junction of flooring and dissimilar materials.
- D. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- F. Jointing Pattern: Lay tile in grid patterns exactly as shown on the Interior Design Drawings. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated. Grout joints shall not exceed 1/8" in width.
- G. Grout tile to comply with requirements of ANSI A108.10, unless otherwise indicated.
- H. Install tile on floors with the following joint widths:
 - 1. Porcelain Tile 1/8 inch.
 - 2. Install floor leveling material as required to achieve floor flatness value to meet mfgs. and TCA handbook, latest edition requirements for grout joint width specified.
 - 3. Confirm tile cutting and joint pattern with Architect at sloped floors and drains.
- I. Stone Thresholds: Install stone thresholds at tile floor transitions at doorways or locations specified, indicated or scheduled; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-portland cement mortar for locations mortar bed would otherwise be exposed above adjacent non-tile floor finish.
- J. Install tile on walls with the following joint widths: grout joints shall not exceed 1/8".
 - 1. Porcelain Tile Trim Units: Match mfgs. joint width of field tile.
- K. Metal Trim: Install metal trim profile as specified, scheduled or shown on the Drawings in accordance with the manufacture's installation requirements. Furnish and install preformed metal joints at inside and outside corners. Butt joints shall be installed with concealed internal splices. Joints shall be kept to a minimum and the trim profiles shall be installed with the longest run of material available without butt joints.
- L. Setting Bed: Install cementitious setting bed at all sloped floors where scheduled or indicated. Coordinate recessed floor requirements prior to cement slab floor placement.

3.4 CLEANING

- A. Clean excess mortar/epoxy from veneer surfaces with water before they harden and as work progresses. Do not contaminate open grout/caulk joints while cleaning. Sponge and wash veneers diagonally across joints. Do not

use acids for cleaning. Polish with clean dry cloth. Remove surplus materials and leave premises broom clean.

3.5 PROTECTION

- A. Protect finished installation under provisions of Division 1 Section "Temporary Facilities and Controls." Close areas to other trades and traffic until tile being installed has set firmly. Keep traffic off horizontal Portland cement thick bed mortar installations for at least 72 hours at 70°F.
- B. Keep floors installed with epoxy adhesive closed to traffic for 24 hrs. at 70°F, and to heavy traffic for 48 hours @ 70°F unless instructed differently by manufacturer. Use kneeling boards, or equivalent, to walk/work on newly tiled floors. Cure tile work in restrooms for 7 days for epoxy based grout and 14 days for latex-Portland cement based grout @ 70°F before walking on the surface. Extend period of protection of tile work at lower temperatures, below 60°F and at high relative humidity (>70% R.H.) due to retarded set times of mortar/adhesives. Replace or restore work of other trades damaged or soiled by work under this section.

3.6 FLOOR TILE INSTALLATION SCHEDULE

- A. Interior floor installation on concrete; thin-set mortar; TCA F113:
 - 1. Prep walls as required for application of new tile work.
 - 2. Thin-Set Mortar: Latex portland cement mortar.
 - 3. Thick-Set Mortar: Where shown, or noted, or scheduled or required for floor leveling areas.
 - 4. Grout: Polymer-modified unsanded grout, epoxy grout at the restrooms.
 - 5. Refer to schedule and drawings for extent and location of tile.

3.7 WALL TILE INSTALLATION SCHEDULE

- A. Interior wall installation; thin-set mortar; over cement board; TCA W243:
 - 1. Thin-Set Mortar: Latex portland cement mortar.
 - 2. Grout: Polymer-modified unsanded grout.
 - 3. Refer to schedule and drawings for extent and location of tile.
- B. GC to supply and install cement backer board for all "wet" wall tile and mosaic tile areas. Reference Specification Section 09260, Gypsum Board Assemblies for cement backer board requirements and products.
- C. **PRE-FLOAT METHOD (FOR FLOOR LEVELING AS REQUIRED)**
- B. Over clean, dimensionally stable and sound concrete or masonry substrates, apply latex-Portland cement mortar as scratch/leveling coat in compliance with

current revision of ANSI A108.1 (A-1 through A-3; A-4.1a.1.4). Float surface of scratch/leveling coat plumb, true and allow mortar to set until firm. For installation of ceramic tile, mosaic, follow *Wall Tile Installation Schedule* (3.7).

3.8 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at NO EXTRA COST to the Owner.

END OF SECTION 09310

SECTION 09511 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Sections:
 - 1. Division 7 Section “Building Insulation” for sound batt insulation.
 - 2. Division 7 Section “Joint Sealants” for sealants.
 - 3. Division 9 Section “Linear Metal Ceilings” for strip linear metal ceilings, and suspension systems for ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, smoke detectors, Unistrut, Owner Furnished Equipment, sprinklers, access panels, special moldings, and starting point for ceiling layout & grid spacing.
 - 4. Note extent of acoustical clg’s on plan layout.
 - 5. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports.

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- F. Maintenance Data: For finishes to include in maintenance manuals.
- G. MFG's Certifications: Confirmation that light fixtures specified will fit into grid without special clips or hardware.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
 - b. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression system, speakers, smoke detectors, Unistrut, Owner Furnished Equipment and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Deliver to location designated by Owner; obtain signed receipt.
 - 2. Acoustical Ceiling Panels: Full-size panels equal to 3 percent of quantity installed for each acoustical tile utilized (2 boxes minimum labeled by space).
 - 3. Suspension System Components: Quantity of each exposed component equal to 3 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: As indicated in Finish Listing.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING:

- A. ACT-1-Basis-of-Design Product (where moisture resistant tile is scheduled): Subject to compliance with requirements, provide the following:
 - 1. Armstrong World Industries, Inc.; "Ceramaguard 605," Square Edge, 2' X 2' x

5/8" Prelude XL 15/16" exposed Tee Grid.

- B. Color: White.
- C. Light Reflectance (LR): Not less than 0.88.
- D. Ceiling Attenuation Class (CAC): Not less than 40.
- E. Edge/Joint Detail: Square.
- F. Antimicrobial Treatment: Humiguard Max.

- G. ACT-2-Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 2. Armstrong World Industries, Inc.; "Cirrus," High NRC- medium texture, Angled Tegular Edge, 2' X 2' x 3/4" except where noted Prelude XL 15/16" exposed Tee Grid.
- H. Color: White.
- I. Light Reflectance (LR): Not less than 0.85.
- J. Noise Reduction Coefficient (NRC): Not less than 0.55.
- K. Ceiling Attenuation Class (CAC): Not less than 35.
- L. Edge/Joint Detail: Angled Tegular.
- M. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
- B. Armstrong World Industries, Inc.; "Prelude XL," 15/16," High Recycled Content (HRC), Exposed Tee. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated or required.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635,

Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft tem per.
 - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.1 06-inch diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees. Provide clips where required @ light fixtures to ensure fit & securement within grid.

2.7 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Do not proceed with installation until all wet work such as concrete, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans & Architect approved shop drawings. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately, with no visible gaps, into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 3. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.5 CLEANING

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

END OF SECTION 09511

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SECTION 09651 – RESILIENT FLOOR TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes Composite resilient flooring tile - VCT.
- B. Related Sections include the following:
 - 1. Section 09653 “Rubber Wall Bases and Accessories”.

1.3 SUBMITTALS

- A. In addition to product data, submit the following.
 - 1. Maintenance data for products specified in this Section, to include in Operating and Maintenance Manual specified in Division 01.
 - 2. Extra Materials: Deliver to Owner not less than one box for each 50 boxes or fraction thereof, of each class, wearing surface, color, pattern, and size of resilient floor tile installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products of the following:
 - 1. Vinyl Composition Tile (VCT)
 - a. Armstrong World Industries, Inc.
 - b. Azrock Commercial Flooring, DOMCO
 - c. Mannington Mills, Inc.
 - d. Tarkett Inc.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Products complying with ASTM F 1066, Composition 1 (nonasbestos formulated), and with requirements specified below:

- 1. Vinyl Composition Floor Tile Product Data:

- a. Class: 2
 - b. Thickness: 1/8"
 - c. Size: 12" x 12"
 - d. Surface: Smooth
 - e. Color(s): As selected by Architect from manufacturer's standard full range.

2.3 CONCRETE SLAB PRIMER

- A. Nonstaining type recommended by flooring manufacturer.

2.4 TROWELABLE UNDERLAYMENTS AND PATCHING COMPOUNDS

- A. Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.

2.5 ADHESIVES (CEMENTS)

- A. Water-resistant type recommended by tile manufacturer to suit resilient floor tile products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas where installation of tiles will occur, with Installer present, to verify that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 before beginning installation:
- C. Comply with manufacturer's installation specifications to prepare substrates indicated to receive tile.

3.2 INSTALLATION

- A. Comply with tile manufacturer's installation directions and other requirements indicated.

- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tile widths at opposite edges of room are equal to one another and are not less than one-half of a tile.
- C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged.
 - 1. Lay tiles with grain running in one direction.
- D. Where demountable partitions and other items are indicated for installing on top of finished tile floor, install tile before these items are installed.

3.3 CLEANING

- A. Clean resilient tile floors after installation and 4 days prior to date scheduled for inspections intended to establish date of Substantial Completion. Apply protective polish according to floor tile manufacturer's directions.

END OF SECTION 09651

(INTENTIONALLY LEFT BLANK)

SECTION 09653 - RUBBER WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 RELATED SECTIONS

- A. Coordinate work of this Section with work of other Sections that are required to properly execute the work and as necessary to maintain satisfactory progress of work of other Sections, including:
 - 1. Section 09651 Resilient Floor Tile for VCT.
 - 2. Section 09681 Carpet Tile for metal transition strips at floor material changes.
 - 3. Section 09656 Static Dissipative Resilient Flooring for anti-static flooring

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Johnsonite
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch.

D. Height: Four inches w/cove base at non-public or back of house areas (Offices, data room, mechanical rooms, storage rooms, etc.) as shown on the Drawings or as scheduled.

1. At public areas of the building (lobbies, hallways, corridors and alcoves adjacent to the public areas, the base shall be Roppe 700 Series or Architect and Owner approved equivalent.
2. Straight edge at carpeted areas and coved base at non-carpeted and tiled areas or where scheduled or noted on the drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: Matte.

I. Colors and Patterns: As selected by Architect and Owner (or Owner's designated representative) from Manufacturer's full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johnsonite
 - b. Burke Mercer Flooring Products: Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Roppe Corporation, USA

B. Description: Nosing for resilient floor covering, Reducer strip for resilient floor covering, and Transition strips at all VCT and concrete floor transitions and openings. Refer to Section 09680 "Carpet" for transition strip requirements for carpet termination at flooring material transitions including tiled and non-tiled surfaces.

C. Material: Rubber.

D. Profile and Dimensions: As indicated or specified Owner (or Owner's designated representative).

- E. Colors and Patterns: As selected by Architect and from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible, minimum 1'-0" length.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips where specified or indicated at edges of concrete and resilient floor covering that would otherwise be exposed at flooring transitions and openings.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 09653

SECTION 09681 – CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes modular carpet tile at walk off areas of the entries or as scheduled.
- B. Related Requirements:
 - 1. Division 9 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:
 - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

1.5 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each carpet, and exposed accessory and for each color and pattern required.
- C. Maintenance data.
- D. Layout drawings at 1/8" scale minimum.

- E. Dyelots: All carpet of the same type in continuous areas should be from the same dye lots.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by manufacturer.
- D. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- E. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- F. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.9 WARRANTY

- A. Carpet Warranty: Provide manufacturer's standard form in which manufacturer agrees to replace carpet that does not comply with requirements or that fails within ten (10) years from date of Substantial Completion. Warranty does not include deterioration or failure of carpet from unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1.10 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
- B. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
- C. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.11 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. Carpet tile attic stock shall be provided in original shipping boxes or wrapping and labeled for each area of use/installation.
 - 2. Deliver all required overages and maintenance stock to Owner's specified location prior to beginning installation. Attic stock shall be from the same dye lot as installed material.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lees Carpets; (Mohawk Group), or comparable product by one of the following:
 - 1. Shaw.
 - 2. Tandus.
- B. Color and Pattern:
 - 1. As scheduled and shown on the drawings or as selected by the Architect and Owner.
- C. Pile Characteristic:
 - 1. Emerging Lights Modular – Tufted-textured loop graphics; 10.6 stitches/ inch
- D. Primary Backing/Backcoating: Lees (Mohawk Group) EcoFlex ICT or Architect approved equal. 35% pre-consumer recycled content, ultra dense modular backing system.
- E. Secondary Backing: Manufacturer's standard fiberglass reinforced thermo plastic composite material.
- F. Size: 24 inches by 24 inches.

- G. Stain Resistance: Soil and stain resistance shall be integral to carpet fiber or shall be applied per manufacturer standards.
- H. Static Control: 3.0 KV when tested under Standard Shuffle test (70 degrees, 20% RH)
- I. Flammability:
 - 1. DOC-FF-1-70 Pill Test: Passes.
 - 2. Floor Radiant Panel: Meets NFPA Class 1 when tested per ASTM-E-648 glue down.
- J. NBS Smoke Chamber NFPA 258: Less than 450 Flaming Mode.
- K. Color Fastness:
 - 1. Lightfastness - AATCC 16E-1982 - Dark color: Gray scale rating of 4 or better after 160 standard fading hours as compared to AATCC Gray Scale for evaluation change in color.
 - 2. Ozone and Gas - AATCC 129-1981 - Rating 3 or better per color AATCC transference scale.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Edge/Transition Strips: Johnsonite – Vinyl “C” or “D” adaptor, or “T” molding for transition between carpet and flooring material transition, or extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints. Carpet to be flush with adjoining tile surface.
 - 1. Schluter – “Reno-T” at equal height flooring transitions.
 - 2. Schluter – “SCHIENE” at carpet to tile transitions.
 - 3. Johnsonite CTA-XX-J 1/4” high x 2½” at perimeter of carpet tile, with mitered corners, between transition of polished concrete and carpet.or
 - 3. Johnsonite EG-XX-H 1/4” high x 2⅛” at perimeter of carpet tile, with mitered corners, between transition of hard surface, vinyl tile or sealed concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 3. Raise subfloors at lobby areas to ensure the carpet is flush with finish floor of tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. General: Do not start work until work of other trades are substantially completed. Inspect surfaces to receive carpet and verify that all such work is complete to the point where this installation may properly commence. In the event of discrepancy, notify the Contractor. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved. Start of carpet installation indicates acceptance of subfloor conditions and full responsibility for completed work.
- E. Materials: Inspect all goods to verify all goods uniformity, quality, color and texture against the approved samples prior to installation. Any discrepancy should be brought to the attention of the Contractor.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

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

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions. Sequence tile installation per manufacturer's instructions to ensure a uniform appearance.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Roll floor with 75 to 100 pound roller per manufacturer's requirements.
- I. Blend and enhance the seams, and trim face yarn as required.
- J. General: In addition to the requirements and recommendations of the Carpet Manufacturer, the following criteria shall be adhered to:
 - 1. Installation layout shall enable future replacement, especially in large open areas and traffic paths, unless specifically indicated in writing by owner or owner's representative.
 - 2. No carpet tile pieces smaller than 6" in width or length shall be used.
 - 3. Seams occurring at doors of different types of carpet shall be parallel to closed door, and be centered directly under the closed door.
 - 4. Flooring Trade Contractor is responsible for trimming all loose yarn and fuzzy edges of carpet tiles.
 - 5. All cutting of carpet for telephone and electrical outlets shall be the responsibility of the Flooring Trade Contractor.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove and dispose of debris and unusable scraps.
 3. Vacuum carpet using two motor, top loading, upright commercial machine with brush-only element, utilizing a high filtration dust bag. Remove spots in accordance with carpet manufacturer's guidelines and replace carpet where spots cannot be removed. Remove any protruding face yarn using sharp scissors. Be certain to trim any loose yarns or fibers at all seams.
 4. Following cleaning and vacuum, carefully protect the carpeting from soiling and damage until final acceptance. Protection shall be accomplished by using approved protection paper. Edges shall be lapped 6 inches and secured with non-asphaltic tape. Covering shall be kept in repair and damaged portions replaced during the construction and move-in period.
 5. Maintenance Materials: Deliver usable, uncut carpet tiles to Owner's designated storage space, properly packaged and identified. Dispose of smaller pieces as construction waste.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations".
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09681

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SECTION 09911 – EXTERIOR PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparations, painting, and finishing of exposed exterior items and surfaces.
 - 1. Surface preparation, priming and finish coats specified in this Section are in addition to shop priming and surface treatment specified under other Sections.
- B. Paint exposed surfaces whether or not colors are designated in “schedule” except where a surface or material is indicated not to be painted or is to remain natural. Where an item or surface is not mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect and Owner will select from standard colors or finishes available.
 - 1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, or labels.
 - 1. Labels: Do not paint over Underwriter’s Laboratories, Factor Mutual or other code-required labels, or equipment name, identification, performance rating, or nomenclature plates.
- D. The Contractor shall apply damp proofing to the interior face of the perimeter new exterior CMU (where walls are to be concealed) walls to reduce moisture intrusion during the course of construction, until the final exterior paint system is applied.
- E. Non-Galvanized Structural Steel to receive fire proofing as scheduled, shown, or required by the IBC, shall be primed by the fabricator but not finished painted.
- F. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages,

Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.3 GENERAL

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as shown, noted, detailed and reasonably implied on the drawings and in the specifications.
- B. Note that warranty requirements are an integral part of the work in this Section and all criteria listed per Article 1.9 of this Section apply.
- C. Note that the requirement for prime and finish painting may be included in various Mechanical, Electrical, Plumbing, Fire Protection, and Structural sections of this specification. Coordination is required.
- D. The Paint Manufacturer shall also provide their own company paint and coatings specifications accompanied by Product Data and Material Safety Data sheets as part of Article 1.6 Submittals below. It is the intent of these Specifications to establish quality and workmanship detail, and define both generic systems and the extent of the caulking and coatings applications in a general way. It shall then be the responsibility of the Paint Manufacturer to attach and comply with their own company paint and coatings specifications for the precise primers and finish coats and application procedure and methods to ensure this criteria is followed.
- E. In the event of discrepancy, the Paint Manufacturer's specifications shall take precedence over these specifications. Notify the Architect in writing for each and every specific situation as it occurs prior to application of any material.
- F. The Paint Manufacturer shall exercise rights of approval in the selection of a competent applicator, which meets their standards for quality workmanship and levels of experience.
- G. Although the Paint Manufacturer may not actually manufacture caulking compounds equivalent to these specified herein, they shall be responsible for this phase of work as described in Article 1.9 of this Section.

1.4 RELATED 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:
 - 1. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
 - 2. Division 7 Section "Sprayed Fire-Resistive Materials."
 - 3. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
 - 4. Division 9 Section "High Performance Coatings"

1.5 DEFINITIONS

- A. "Paint" includes coating system materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.6 SUBMITTALS

- A. Data: Submit product data under provisions of Section 01300 – Shop Drawings, Product Data and Samples to include the Paint Manufacturer's application instructions for all products intended for work in this Section.
- B. Painting Schedule: Shall include, but not limited to the following:
 - 1. Pretreatment requirements for each paint system.
 - 2. Spread Rate - gallons per square foot.
 - 3. Wet film thickness in mils.
 - 4. Dry film thickness in mils.
 - 5. Total dry film thickness in mils.
 - 6. Format identical to Article 3.9 PAINT SCHEDULE
- C. Samples:
 - 1. Submit manufacturer's standard color chips. Architect and Owner will select colors from manufacturer's color chip brochures. Contractor to prepare color chip samples specified herein before using selected colors. Architect and Owner will make final selection from such color chips and prepare color schedule for Contractor's use.
 - 2. Do not proceed with any painting work until field sample panels of each paint system specified are applied and reviewed by the Architect and Owner.
- D. Applicator Certification: Written acceptance of the applying company per Article 1.9 D. of this section.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.
- B. Deliver all materials to the job site in original, new and unopened packages and containers bearing the manufacturer's name and label, and the following

information:

1. Product name or title of material,
2. Product description (generic classification or binder type).
3. Manufacturer's name, stock number and date of manufacture.
4. Contents by volume, for major pigment and vehicle constituents,
5. Thinning instructions,
6. Application instructions,
7. Color name and number,
8. No materials other than types specified or approved may be delivered to project site. Unapproved materials shall be removed from project site immediately.

C. Storage and Use of Premises:

1. The applicator shall confine his apparatus, materials storage and operations of his workers to limits indicated by Contractor. All materials used on the job shall be stored in a single place designated by the Contractor. Such storage shall be kept clean and the applicator shall be liable for damage to surrounding areas.
2. Inflammable material and/or fire hazard waste shall be stored, handled and used in an approved manner and shall be removed from the site daily.

D. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degrees F., or as required by the manufacturer. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
2. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8 JOB CONDITIONS

- A. Paint only in dry weather when temperature is 50 degrees F or higher. Stop exterior work early to permit paint film to set up before condensation, caused by night temperature drops, occur. Do not begin painting until surfaces are moisture free.

- B. Do not varnish or enamel in direct sunlight.
- C. Keep paint at room temperature.
- D. Sweep dust, dirt and debris away before painting.
- E. Execute work in accordance with label directions. Coating applications shall be made in strict conformance to this specification and to the manufacturer's paint instructions on the labels and product data sheets.
- F. Paint only dry wood (less than 15 percent moisture). Defer painting until moisture content meets manufacturer's recommendations.
- G. Environmental Requirements:
 - 1. Measure moisture content of surfaces using an electronic moisture meter. Do not apply coating unless moisture content of surfaces is below the manufacturer's recommendations.
 - 2. Paint PH tests shall be taken prior to painting subcontractor beginning his work. PH level to be acceptable to paint manufacturer and subcontractor prior to paint application. Costs of tests to be paid by painting contractor. Provide written documentation of all test results immediately to on-site General Contractor's superintendent.
 - 3. Strictly follow manufacturer's recommendations pertaining to environmental conditions.
- H. All work shall be accomplished by skilled workmen familiar with and trained to do this type of work and they shall be further qualified to operate or use the equipment and rigging needed to accomplish this work.
- I. Materials shall be applied evenly and free of runs, sags, or pinholes.
- J. Type and amount prescribed for thinners, solvents, cleaners, etc. to be confirmed by and based on the Paint Manufacturer's written recommendation and approval.
- K. All application tools and equipment shall be in good working order and suitable for proper application. All surrounding areas shall be fully protected against damage during each stage of the painting project. All exterior and interior substrates designated not to receive paint coatings shall be kept free of paint residue, e.g. windows, etc.
- L. Normal safety signs, necessary lighting and temporary fencing around work areas shall be installed and maintained in accordance with OSHA requirements while work is in progress.
- M. Where spray painting has been approved by the Architect, this applicator shall protect all adjacent materials and surfaces by covering entire said areas with approved protective materials. Overspray will not be accepted and, if it occurs,

shall be cleaned up properly and promptly.

- N. The applicator shall submit written evidence of insurance coverage of an adequate amount to cover the cost of cleaning and/or repairing vehicles and other property which may be damaged by his work. The applicator shall use all precautions to avoid paint movement and shall notify the Contractor to have vehicles removed from susceptible areas.
- O. A progress schedule shall be furnished by the applicator for approval and shall be based on the contract completion date. Applicator shall advise the Contractor of those areas in which work is to be performed 1 week in advance of the work schedule to permit the Contractor to prepare for the work, advise employees, move vehicles, etc.

1.9 QUALITY ASSURANCE

- A. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime and/or finish paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish material proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and prime as required. Notify the Contractor in writing of any anticipated problems using specified coating systems with substrates primed by others.
- B. Examine specification sections of their trades for painting requirements, provisions therein affecting work of this Section.
- C. Materials or work left unfinished by requirements of such other specifications but which are required to be painted shall be painted, finished to completion as part of work of this Section.
- D. The applicator's qualifications, experience, etc., require the written approval and acceptance by the Paint Manufacturer.
- E. Material Quality: Provide the manufacturer's best quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1.10 INSPECTION

- A. Applicator must examine the areas and conditions under which painting work is to be applied and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.
- B. Starting of painting work will be construed as the Applicator's acceptance of the surfaces and conditions within any particular area.

- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.
- D. Dry film thickness will be checked with a properly calibrated Nordson Mikrotest Dry Film Thickness Gauge or by other specifically approved instruments.
- E. It will be the Applicator's responsibility to own and use a wet film thickness gauge to check his application thickness as he proceeds.
- F. Small sample areas of each phase of work shall be done and checked by the Paint Manufacturer's representative. This will serve upon acceptance by the Architect and Owner as the job standard for remainder of that phase of work. This will also prevent misunderstanding as to interpretation of this specification's standards.
- G. The Applicator shall advise the Paint Manufacturer's representative and Architect with enough lead-time prior to beginning each phase of work in order for inspection to not cause a delay in the work of the Applicator.
- H. The Paint Manufacturer's representative shall be required to submit written reports to the Architect, Owner, Applicator and Contractor on the progress of satisfactory applications that will include initial job sample applications, and at least bi-weekly reports, that all work is being accomplished in accordance with his approval. These reports shall be a required attachment to each applicable Application for Payment. (Note that they apply to painting work only.) Refer to Section 00950 – Quality Assurance.
- I. A final report to the Architect shall notify all parties that the completed work has been done in accordance with the manufacturer's recommendations, and the warranty period commences at the date of substantial completion. Acceptance must be in writing and presented no later than 10 days from receipt of final report, unless a written notice of specification deficiencies is necessary. Under such circumstances, the deficiencies shall then be corrected and new letters of completion and acceptance shall be exchanged.

1.11 SURFACE PREPARATION

- A. Each surface shall be cleaned and prepared as specified in accordance with the Paint Manufacturer's surface preparation recommendations and requirements. The applicator is responsible for the finish of his work. Should any surface be found unsuitable to produce a proper paint or sealant finish, the Contractor shall be notified in writing and no material shall be applied until the unsuitable surfaces have been made satisfactory.
- B. All exterior surfaces to be painted shall be cleaned to remove dirt, mildew, chalked paint and any foreign materials deterrent to the new finish and allowed to completely dry before painting.
- C. Cracking that cannot be bridged by the paint film shall be brought to the attention of the Contractor who shall then direct repairs by the proper party.

- D. Unprimed metals shall be mechanically hand tooled to bright metal and primed with a universal rust inhibitive primer as recommended by the Paint Manufacturer.
- E. Painted wood surfaces shall be carefully inspected for evidence of deterioration or surface imperfections. Sandpaper any hard, glossy surface to ensure proper adhesion. Fill nail holes, imperfections and cracks with putty. Edges, corners, and raised grain shall be eased by sanding. Each coat required shall be sanded except the last. For surfaces scheduled to receive a prime coat only, sand, and re-prime after initial coat as required to conceal any defects due to insufficient sealing. Wood trim that is scheduled to be painted shall be spray painted; brush painting will not be acceptable.
- F. Any loose and scaling shop painted item shall be cleaned by hand wire brushing or other suitable power tool cleaning as per SSPC-SP2 "Hand Tool Cleaning" or SSPC-SP3 "Power Tool Cleaning" standards then spot primed per the paint manufacturer's instructions.
- G. Masonry and Concrete Repair, Patching and Caulking/Sealant Procedure:
1. Prior to any caulking or crack repair, all substrates must be cleaned to remove all mildew, dirt, loose or peeling paint, or any other foreign matter. Allow proper drying time of substrates before application of the products. Cracks shall be primed with a thinned solution of Pigmented Bonding Coat before any patching or caulking material is applied.
 2. All construction joints and expansion joints shall be carefully inspected and cleaned prior to painting to assure desired adhesion to both surfaces.
 3. Sound out all masonry/concrete cracks to determine bond to substrate. If hollow sound or disbonding is evident, immediately notify the Contractor in writing and proceed per Article 1.7 A. of this Section.
 4. Concrete primer and concrete patching materials shall be approved by The Paint Manufacturer's representative and Architect before application.
 5. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline, to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions. Plaster shall be neutralized with manufacturer's Plaster Surface Conditioner; burned spots shall be touched up.
- H. Galvanized Metal Surfaces: Galvanized metal surfaces shall be pretreated and wiped with a biodegradable cleaner to remove any dirt, oil or grease. The galvanized surfaces shall be prepared and primed prior to application of the finish coat(s) of paint as recommended by the paint manufacturer.
- I. Hollow Metal Exterior Door Frames: The back of all exterior door frames shall be

primed with a bituminous mastic primer, from the bottom of the door to 18 inches above finish floor.

1.12 WARRANTY

A. Work performed to Specifications will be warranted as follows:

1. The Paint Manufacturer warrants to the building Owner and to the Contractor that for five (5) years after the date of substantial completion for the application of all coatings scheduled in Article 3.9 "Painting Schedule", Section 09911 – Exterior Painting of the project specifications and installed by the Painting Contractor, these coatings will be free from defects in manufacture and will conform to manufacturer's specifications for these products. In addition, if the Contractor applies each coating in accordance with the manufacturer's specification for application as noted below, the Paint Manufacturer warrants to the building Owner and to the Contractor that the product so applied will perform satisfactorily for three (3) years under installed conditions and will provide normal and customary protection of the substrate and will not crack, peel or blister for five (5) years under installed conditions. The warranty applies only to above-grade coated surfaces and does not apply to conditions caused by structural defect, building settlement or building movement as determined and certified by the project Structural Engineer, vandalism, negligence or other causes beyond the Paint Manufacturer's control.
2. The Paint Manufacturer representative will be given full and complete access to the job site during all stages of the construction. The paint manufacturer's representative will:
 - a. Inspect all surfaces prior to paint application.
 - b. Provide detailed written specifications for surface preparation, sealing, curing time, temperature, coatings specifications, or special application procedures for each scheduled coating.
 - c. Provide all reports, testing, monitoring, checking, etc. as listed in the project specification Section 09911 - Exterior Painting for this project.
4. Any claim made under this warranty must be in writing within thirty (30) days of the alleged product failure. "The paint manufacturer makes no other warranties, express or implied," including without extending or limiting the duration provided by law of any implied warranty or warranty of fitness for purpose or use." In the event that the installed product fails to conform to the above warranties, written notification will be forwarded to the Paint Manufacturer as noted above.

Within thirty (30) days, a response detailing the Paint Manufacturer's analysis and recommendations including the Contractor's schedule for required remedial actions will be provided for coordination with the Architect and Owner. Any recoated areas will be warranted only for the remainder of the original warranty period, which shall not be extended as a

result of the supply of replacement materials or labor.

Provide a signature element that includes the name and title of the signatories for the Paint Manufacturer, the building Owner, the Contractor, the date of substantial completion/warranty effective date, and the project name and address.

By issuing this warranty, the Paint Manufacturer and this contractor confirm that said warranty shall include and cover the Paint Manufacturer's costs relating to corrective or replacement paint, coatings or sealant work needed to re-establish the integrity of the paint for this project. This includes all labor and materials. This warranty shall apply to excessive cracking, chipping, peeling, or disbonding of the paint from any substrate. It is understood that minor fading is expected; however, any catastrophic discoloration or loss of color shall also be covered by said warranty.

1.13 MOCK-UPS

- A. Prepare a field sample application of each scheduled paint color (mock-up) at locations approved by the Architect. Each mock-up shall cover approximately 4 square feet of area (2'-0" by 2'-0"). Apply mock-ups in quantities of paint colors selected and furnished by the Owner or Architect. Upon approval of preliminary colors by the Owner and the Architect, furnish final mock-ups.
- B. At finished construction locations as directed and approved by the Architect, provide final painting field mock-ups to cover approximately 100 square feet of area (10'-0" by 10'-0") using final colors per Article 1.10 above. Mock-ups are to represent conditions of finished work including one typical horizontal to vertical interface for both interior and exterior conditions as well as typical wall surfaces.
- C. Mock-ups approved by the Owner shall constitute standard of acceptance for remaining work. Do not disturb or alter mock-ups during remaining construction.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Basis of Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The) or comparable product by one of the following:
 - 1. PPG Paints.
 - 2. Porter Paints
 - 3. Devoe/ICI Paints
- B. Manufacturers: Subject to compliance with the project requirements and specifications, provide products specified below or an Architect approved equal. The burden of proof of equality is on the proposer.
- C. Substitutions: Where a selected manufacturer or product has been specified, and equal or superior product or change in manufacturer may be accepted only upon

review and written acceptance by the Architect. All such proposed changes or substitutions shall be submitted to the Architect with appropriate manufacturer's specifications and literature, environmental compliance assurance and independent laboratory testing data, and side by side comparative for each product type. The Architect's decision whether a product or manufacturer is equal or superior to the one specified shall be final. Refer to Division 01 for additional product substitution requirements.

- A. All materials used in this paint contract shall be as manufactured and delivered on the job in original, sealed containers.
- B. The paints herein specified are known to be suitable and will be enforced as the required standards of quality of this work.
- C. Extra Materials: Provide 10-gallons of each selected color for maintenance stock to the Owner.
- D. Provide a final typed painting schedule to be included in Section 01700 – Project Closeout with maintenance manuals.
- E. All coatings shall contain the mildewcide M-1 additive, or paint manufacturer's approved equal, as manufactured by Jomaps, Inc. The quantity of the additive shall be per the manufacturer's requirements in order to provide mildew resistance.
- F. Damp proofing to be applied to the interior face of the perimeter exterior CMU walls shall be "Dry-Lock", or approved equal.

2.2 COLORS

- A. Colors of the exterior building envelope shall be as selected by the Owner, and the Architect, Color schedules shall be furnished to the Applicator before application of prime coats. Prime coats will be tinted to be a slightly different shade compared to the succeeding coat.
- B. Colors of the storage and mechanical rooms will be a single color; antique white or similar to be approved by the Owner and Architect.

PART 3 -EXECUTION

3.1 INSPECTION

- A. Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Painting contractor shall notify the General Contractor in writing if repair or replacement of any damaged or otherwise unacceptable substrates exist or is necessary. Verify that painting may be completed in strict accordance with the project requirements/specifications and with the manufacturer's recommendations. Do not proceed until all such discrepancies have been fully resolved.

- B. All work will be inspected and approved in writing, on a regular basis by the paint manufacturer's representative. A schedule of inspections required of the manufacturer will be reviewed and coordinated with the General Contractor prior to the commencement of the painting work.
1. The minimum inspection requirements prior to start of each area or drop are:
 - a. Verify that surfaces are ready to receive work.
 - b. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
 - c. Verify that substrate moisture content and PH do not exceed recommended conditions as predetermined by all parties involved.
 - d. Examine all caulk joints for use of appropriate sealant, adequate application and adequate adhesion.
 2. Minimum testing during application:
 - a. Moisture.
 - b. PH test.
 - c. Wet mil test of base application.
 - d. Dry mil test of base application.
 - e. Wet mil test of finish coat(s).
 3. Minimum upon completion:
 - a. Dry mil test of completed application.
 - b. Summary report of all testing and copies of all field testing reports.

3.2 SURFACE PREPARATION

- A. General: Clean and prepare surfaces to be painted in accordance with manufacturer's printed instructions and current recommendations for each particular substrate condition and as specified.
1. Notify the Architect and General Contractor in writing of problems anticipated using specified finish coat material with substrates primed by others.

2. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and items in place that are not to be painted, or provide suitable protection prior to surface preparation and painting. Remove items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, reinstall items removed using workmen skilled in the trades involved.
 3. Clean surfaces before applying paint or surface treatment. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- B. Cementitious Surfaces: Prepare concrete, concrete masonry, and similar surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. Use abrasive blast cleaning if recommended by paint manufacturer.
1. Determine alkalinity and moisture content of surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- C. Wood: Clean surfaces of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper as required. Sand surfaces exposed to view smooth, and dust off.
1. Scrape and clean, small, dry, seasoned knots and apply a thick coat of white shellac or other recommended knot sealer, before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood.
 3. When transparent finish is required, use spar varnish for back priming.
 4. Seal tops, bottoms, ends and cutouts of unprimed wood doors and pre-engineered wood beams with heavy coat of varnish or sealer immediately upon delivery.
- D. Ferrous Metals: Clean non-galvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
1. Touch-up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- E. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pre-treatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

- G. Doors: Door bottoms and tops shall be primed and painted prior hanging the doors. The Contractor shall coordinate the timing of the work to ensure that this process is completed prior to hanging the doors within the frame.

3.3 GENERAL

- A. Protect work of other trades, whether to be painted or not, from damage by painting work. Mask hardware as required to protect, i.e. brass door butts, etc.
- B. Provide "Wet Paint" signs where appropriate to protect uncured finishes.
- C. Spray applications, when used, shall produce the equivalent hiding quality per coat as brush or roller-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass. All spray applied paint shall be "back rolled" to assure proper coverage and uniformity.
- D. The first and second coats of paint will be of slightly different shades for inspection purposes.
- E. Viscosity and thickness tests may be taken by the General Contractor or manufacturer. Cost of tests will be borne by the subcontractor if found to be below specification requirements.
- F. Painter to protect floors from over-spray and to clean if necessary.
- G. All weather stripping around doors, windows and other openings shall not be painted. Special care shall be taken to properly "mask" and protect these components from all painting operations.
- H. Subcontractor shall provide adequate painting protection for all of the trades work throughout the painting operations. Once surrounding services have been painted and protection is no longer needed, temporary protection shall be removed.
- J. Clean all surfaces of foreign matter prior to any paint application.

3.4 MATERIALS PREPARATION

- A. Mix and prepare paint in accordance with manufacturer's directions. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
- B. Use factory mixed colors, shade, and tints. Job mixing permitted only with specific written approval of the Paint Manufacturer's representative and the Architect.
- C. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

- D. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.
- E. Use only thinners approved by manufacturer, and only within recommended limits.

3.5 APPLICATION

- A. Apply paint of consistency recommended by and in accordance with the paint manufacturer's data sheets. Use tools and techniques best suited for the substrate and type of material being applied per manufacturer's data sheets.
- B. Paint interior surfaces of ducts where visible through registers or grilles, with a flat, non-specular black paint as per paint schedule.
- C. Finish exterior and interior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.
- D. Exposed pipes and ductwork on or near walls or ceilings that are to be painted shall be painted, unless otherwise indicated.
- E. Orange peel/rough finish on metal or wood surfaces shall not be permitted.
- F. Provide primer coats for all walls and trim to receive a faux finish. Faux finishes are not included in this contract.
- G. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth, even surface, in accordance with the manufacturer's directions.
- H. Apply additional coats when undercoats show through final coat of paint, until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry-film-thickness equivalent to that of flat surfaces.
- I. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
- J. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
- K. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

- L. Finish exterior doors on tops, bottoms, and side edges same as exterior faces. The back of hollow metal-exterior door frames shall be finished with a mastic primer, from the bottom of the door to 18 inches above the finish floor.
- M. Omit primer on metal surfaces that have been shop-primed and touch up painted.
- N. Sand lightly between each succeeding enamel or varnish coat.
- O. Scheduling Painting: Apply first-coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable, and before subsequent surface deterioration. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- P. Minimum Coating Thickness: Apply materials at the manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by the manufacturer.
- Q. Block Fillers: Apply block fillers to concrete masonry unit at a rate to ensure complete coverage with pores filled.
- R. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material required to be painted or finished, and has not been prime coated by others.
 - 1. Recoat primed and sealed substrates where evidence of suction spots or unsealed areas in the first coat appears, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- S. Brush Application: Brush-out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Draw neat glass lines and color breaks.
 - 1. Apply primers and first coats by brush unless manufacturer's instructions permit use of mechanical applicators.
- T. Mechanical Applications: Use mechanical methods for paint application when permitted by manufacturer's recommendation, governing ordinances, and trade union regulations.
 - 1. Wherever spray application is used, apply coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment building-up film thickness of two coats in one pass unless recommended by the manufacturer.
- U. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirement.

3.6 FIELD QUALITY CONTROL

- A. The Owner reserves the right to engage the services of an independent testing laboratory to sample and test paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.
 - 1. The testing laboratory will perform appropriate tests as required by the Owner.
 - 2. If tests show material being used does not comply with specified requirements, the Contractor may be directed to stop painting pay for testing, repaint surfaces coated with reject paint, remove rejected paint from previously painted surfaces if, upon repainting with the specified paint, the two coatings are non-compatible.

3.7 CLEAN UP AND PROTECTION

- A. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans, and rags at the end of each workday.
- B. Remove splashed, dropped, spattered, and spilled paint from hardware, fixtures, glass, and building parts.
- C. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing, or replacing, and repainting as acceptable to the Architect.
- D. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- E. At the completion of work of other trades, and after notification in writing to the Contractor, touch-up and restore all damaged or defaced painted surfaces. A touch-up allowance will be included in final contract.

3.9 PAINT SCHEDULE

3.9.1 COLOR SCHEDULE EXTERIOR PAINTING

Exterior Building Colors to be selected by the Architect from manufacturer standard colors and approved by Owner.

Color "A"	ICI# XXXXX color (Walls)
Color "B"	ICI# XXXXX color (Doors & Door Frames, Shutters & Fixed Window Shades)
Color "C"	ICI# XXXXX color (Trim & Fascia)

3.9.2 PAINT SYSTEMS AND COATING SCHEDULE

Refer to the Exterior Elevations for the color scheme and various painted material types (letter designation) scheduled below. Provide finish scheduled below if not indicated on the drawings and/or finish schedule.

- A. THE SHERWIN WILLIAMS COMPANY: Attached are the Material Supplier's detailed prime and finish coats specifications. This defines primer and finish coat names, product number designations, and thickness. Because this supplier is providing a warranty, strict adherence to product Data Sheet and label instructions shall be followed. The following schedule shall not be considered as entirely inclusive, but construed as a general guide for complete painting of buildings, structures, etc., including, but not limited to, storage spaces, recesses, returns, reveals, soffits, haunches, forming part of a particular surface, room or space, pipes, conduits, duct work, panels, mechanical equipment, etc.

FINISH TYPE	Wet Film Thickness MILS	Dry Film Thickness MILS	Spread Rate SF/Gal.
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A1. Parking Stripes

1st coat	Sherwin Williams Pro/Mar Traffic Marking Paint B29 Series 4" Stripe	14.0	7.0	350
2nd coat	Sherwin Williams Pro/Mar Traffic Marking Paint B29 Series	14.0	7.0	350

TOTAL DRY MILS 14.0

B1. Structural Steel

1st coat	Sherwin Williams Kern Komick Universal Metal Primer B50 Series	6.0	3.0	200
2nd coat	Sherwin Williams A-100 Exterior Gloss Latex, A8 Series	4.0	3.0	200

TOTAL DRY MILS 4.3

B2. Structural Steel Touch-Up

1st coat	Sherwin Williams Kern Komick Universal Metal Primer B50	6.0	3.0	200
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B3. Unfinished Ferrous Metals

1st coat	Sherwin Williams Kern Komick Universal Metal Primer B502	6.0	3.0	200-250
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2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-650 Series	6.0	2.5	200
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TOTAL DRY MILS 5.5

B4. Exterior Galvanized Metal
 (If Galvanized Metal is Surface Treated, must Solvent Clean with Biodegradable Cleaner)

1st coat	Sherwin Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series	7.5	3.0	264
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-650 Series	6.0	2.5	200

TOTAL DRY MILS 5.5

B5. Galvanized

1st coat	Sherwin Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series	7.5	3.0	264
2nd coat	Sherwin Williams A-100 Gloss A-8 Series	4.0	1.3	3
3rd coat	Sherwin Williams A-100 Gloss A-8 Series	4.0	1.3	300

TOTAL DRY MILS 5.6

B6. Galvanized Surface touch-up

1st coat	Sherwin Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series	7.5	3.0	264
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B7. Unprimed Ferrous Metal and Overhead Grille Brackets

Pretreatment: Clean in accordance with Paragraph 1.11D.

1st coat	Sherwin Williams Kern Komick Universal Metal Primer B50	6.0	3.0	200
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600	6.0	2.5	200

TOTAL DRY MILS 5.5

C1. Wood Stain/Sealer-Semi Transparent

Pretreatment: Prepare surface in accordance with mfg. requirements.

1st coat	Sherwin Williams WoodScapes® Semi-Transparent Stain-Color TBD, A15 Series			200
2nd coat	Sherwin Williams WoodScapes Semi-Transparent Stain-Clear, A15 Series			200

D1. Exterior Sealant

Stampede-Acrylic Urethane Sealant

END OF SHERWIN WILLIAMS COMPANY PAINT SYSTEMS SCHEDULE

END OF SECTION 09911

SECTION 09912 – INTERIOR PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparations, painting, and finishing of exposed interior items and surfaces.
 - 1. Surface preparation, priming and finish coats specified in this Section are in addition to shop priming and surface treatment specified under other Sections.
- B. Paint exposed surfaces whether or not colors are designated in “schedule” except where a surface or material is indicated not to be painted or is to remain natural. Where an item or surface is not mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect and Owner will select from standard colors or finishes available.
 - 1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, or labels.
 - 1. Labels: Do not paint over Underwriter’s Laboratories, Factor Mutual or other code-required labels, or equipment name, identification, performance rating, or nomenclature plates.
- D. The Contractor shall apply damp proofing to the interior face of the perimeter New exterior CMU walls to (where concealed) reduce moisture intrusion during the course of construction, until the final exterior paint system is applied.
- E. Non-Galvanized Structural Steel to receive fireproofing as scheduled, shown, or required by the FBC shall be primed by the fabricator but not finished painted.
- F. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages,

Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.3 GENERAL

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as shown, noted, detailed and reasonably implied on the drawings and in the specifications.
- B. Note that warranty requirements are an integral part of the work in this Section and all criteria listed per Article 1.9 of this Section apply.
- C. Note that the requirement for prime and finish painting may be included in various Mechanical, Electrical, Plumbing, Fire Protection, and Structural sections of this specification. Coordination is required.
- D. The Paint Manufacturer shall also provide their own company paint and coatings specifications accompanied by Product Data and Material Safety Data sheets as part of Article 1.6 Submittals below. It is the intent of these Specifications to establish quality and workmanship detail, and define both generic systems and the extent of the caulking and coatings applications in a general way. It shall then be the responsibility of the Paint Manufacturer to attach and comply with their own company paint and coatings specifications for the precise primers and finish coats and application procedure and methods to ensure this criteria is followed.
- E. In the event of discrepancy, the Paint Manufacturer's specifications shall take precedence over these specifications. Notify the Architect in writing for each and every specific situation as it occurs prior to application of any material.
- F. The Paint Manufacturer shall exercise rights of approval in the selection of a competent applicator, which meets their standards for quality workmanship and levels of experience.
- G. Although the Paint Manufacturer may not actually manufacture caulking compounds equivalent to these specified herein, they shall be responsible for this phase of work as described in Article 1.9 of this Section.

1.4 RELATED 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:
 - 1. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
 - 2. Division 7 Section "Sprayed Fire-Resistive Materials" and "Caulking and Sealants."
 - 3. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.

4. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.5 DEFINITIONS

- A. "Paint" includes coating system materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.6 SUBMITTALS

- A. Data: Submit product data under provisions of Section 01300 – Shop Drawings, Product Data and Samples to include the Paint Manufacturer's application instructions for all products intended for work in this Section.
- B. Painting Schedule: Shall include, but not limited to the following:
 1. Pretreatment requirements for each paint system.
 2. Spread Rate - gallons per square foot.
 3. Wet film thickness in mils.
 4. Dry film thickness in mils.
 5. Total dry film thickness in mils.
 6. Format identical to Article 3.8 PAINT SCHEDULE
- C. Samples:
 1. Submit manufacturer's standard color chips. Architect and Owner will select colors from manufacturer's color chip brochures. Contractor to prepare color chip samples specified herein before using selected colors. Architect and Owner will make final selection from such color chips and prepare color schedule for Contractor's use.
 2. Do not proceed with any painting work until field sample panels of each paint system specified are applied and reviewed by the Architect and Owner.
- D. Applicator Certification: Written acceptance of the applying company per Article 1.9 D. of this section.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.
- B. Deliver all materials to the job site in original, new and unopened packages and

containers bearing the manufacturer's name and label, and the following information:

1. Product name or title of material,
2. Product description (generic classification or binder type).
3. Manufacturer's name, stock number and date of manufacture.
4. Contents by volume, for major pigment and vehicle constituents,
5. Thinning instructions,
6. Application instructions,
7. Color name and number,
8. No materials other than types specified or approved may be delivered to project site. Unapproved materials shall be removed from project site immediately.

C. Storage and Use of Premises:

1. The applicator shall confine his apparatus, materials storage and operations of his workers to limits indicated by Contractor. All materials used on the job shall be stored in a single place designated by the Contractor. Such storage shall be kept clean and the applicator shall be liable for damage to surrounding areas.
2. Inflammable material and/or fire hazard waste shall be stored, handled and used in an approved manner and shall be removed from the site daily.

D. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45 degrees F., or as required by the manufacturer. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
2. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8 JOB CONDITIONS

- A. Paint only in dry weather when temperature is 50 degrees F or higher. Stop exterior work early to permit paint film to set up before condensation, caused by night temperature drops, occur. Do not begin painting until surfaces are moisture free.

- B. Do not varnish or enamel in direct sunlight.
- C. Keep paint at room temperature.
- D. Sweep dust, dirt and debris away before painting.
- E. Execute work in accordance with label directions. Coating applications shall be made in strict conformance to this specification and to the manufacturer's paint instructions on the labels and product data sheets.
- F. Paint only dry wood (less than 15 percent moisture). Defer painting until moisture content meets manufacturer's recommendations.
- G. Environmental Requirements:
 - 1. Measure moisture content of surfaces using an electronic moisture meter. Do not apply coating unless moisture content of surfaces is below the manufacturer's recommendations.
 - 2. Paint PH tests shall be taken prior to painting subcontractor beginning his work. PH level to be acceptable to paint manufacturer and subcontractor prior to paint application. Costs of tests to be paid by painting contractor. Provide written documentation of all test results immediately to on-site General Contractor's superintendent.
 - 3. Strictly follow manufacturer's recommendations pertaining to environmental conditions.
- H. All work shall be accomplished by skilled workmen familiar with and trained to do this type of work and they shall be further qualified to operate or use the equipment and rigging needed to accomplish this work.
- I. Materials shall be applied evenly and free of runs, sags, or pinholes.
- J. Type and amount prescribed for thinners, solvents, cleaners, etc. to be confirmed by and based on the Paint Manufacturer's written recommendation and approval.
- K. All application tools and equipment shall be in good working order and suitable for proper application. All surrounding areas shall be fully protected against damage during each stage of the painting project. All exterior and interior substrates designated not to receive paint coatings shall be kept free of paint residue, e.g. windows, etc.
- L. Normal safety signs, necessary lighting and temporary fencing around work areas shall be installed and maintained in accordance with OSHA requirements while work is in progress.
- M. Where spray painting has been approved by the Architect, this applicator shall protect all adjacent materials and surfaces by covering entire said areas with approved protective materials. Overspray will not be accepted and, if it occurs,

shall be cleaned up properly and promptly.

- N. The applicator shall submit written evidence of insurance coverage of an adequate amount to cover the cost of cleaning and/or repairing vehicles and other property which may be damaged by his work. The applicator shall use all precautions to avoid paint movement and shall notify the Contractor to have vehicles removed from susceptible areas.
- O. A progress schedule shall be furnished by the applicator for approval and shall be based on the contract completion date. Applicator shall advise the Contractor of those areas in which work is to be performed 1 week in advance of the work schedule to permit the Contractor to prepare for the work, advise employees, move vehicles, etc.

1.9 QUALITY ASSURANCE

- A. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime and/or finish paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish material proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and prime as required. Notify the Contractor in writing of any anticipated problems using specified coating systems with substrates primed by others.
- B. Examine specification sections of their trades for painting requirements, provisions therein affecting work of this Section.
- C. Materials or work left unfinished by requirements of such other specifications but which are required to be painted shall be painted, finished to completion as part of work of this Section.
- D. The applicator's qualifications, experience, etc., require the written approval and acceptance by the Paint Manufacturer.
- E. Material Quality: Provide the manufacturer's best quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1.10 INSPECTION

- A. Applicator must examine the areas and conditions under which painting work is to be applied and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.
- B. Starting of painting work will be construed as the Applicator's acceptance of the surfaces and conditions within any particular area.

- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.
- D. Dry film thickness will be checked with a properly calibrated Nordson Mikrotest Dry Film Thickness Gauge or by other specifically approved instruments.
- E. It will be the Applicator's responsibility to own and use a wet film thickness gauge to check his application thickness as he proceeds.
- F. Small sample areas of each phase of work shall be done and checked by the Paint Manufacturer's representative. This will serve upon acceptance by the Architect and Owner as the job standard for remainder of that phase of work. This will also prevent misunderstanding as to interpretation of this specification's standards.
- G. The Applicator shall advise the Paint Manufacturer's representative and Architect with enough lead-time prior to beginning each phase of work in order for inspection to not cause a delay in the work of the Applicator.
- H. The Paint Manufacturer's representative shall be required to submit written reports to the Architect, Owner, Applicator and Contractor on the progress of satisfactory applications that will include initial job sample applications, and at least bi-weekly reports, that all work is being accomplished in accordance with his approval. These reports shall be a required attachment to each applicable Application for Payment. (Note that they apply to painting work only.) Refer to Section 00950 – Quality Assurance.
- I. A final report to the Architect shall notify all parties that the completed work has been done in accordance with the manufacturer's recommendations, and the warranty period commences at the date of substantial completion. Acceptance must be in writing and presented no later than 10 days from receipt of final report, unless a written notice of specification deficiencies is necessary. Under such circumstances, the deficiencies shall then be corrected and new letters of completion and acceptance shall be exchanged.

1.11 SURFACE PREPARATION

- A. Each surface shall be cleaned and prepared as specified in accordance with the Paint Manufacturer's surface preparation recommendations and requirements. The applicator is responsible for the finish of his work. Should any surface be found unsuitable to produce a proper paint or sealant finish, the Contractor shall be notified in writing and no material shall be applied until the unsuitable surfaces have been made satisfactory.
- B. All interior surfaces to be painted shall be cleaned to remove dirt, mildew, chalked paint and any foreign materials deterrent to the new finish and allowed to completely dry before painting.
- C. Cracking that cannot be bridged by the paint film shall be brought to the attention of the Contractor who shall then direct repairs by the proper party.

- D. Unprimed metals shall be mechanically hand tooled to bright metal and primed with a universal rust inhibitive primer as recommended by the Paint Manufacturer.
- E. Painted wood surfaces shall be carefully inspected for evidence of deterioration or surface imperfections. Sandpaper any hard, glossy surface to ensure proper adhesion. Fill nail holes, imperfections and cracks with putty. Edges, corners, and raised grain shall be eased by sanding. Each coat required shall be sanded except the last. For surfaces scheduled to receive a prime coat only, sand, and re-prime after initial coat as required to conceal any defects due to insufficient sealing. Wood trim that is scheduled to be painted shall be spray painted; brush painting will not be acceptable. Wood floors shall receive (4) four coats of sealer.
- F. Any loose and scaling shop painted item shall be cleaned by hand wire brushing or other suitable power tool cleaning as per SSPC-SP2 "Hand Tool Cleaning" or SSPC-SP3 "Power Tool Cleaning" standards then spot primed per the paint manufacturer's instructions.
- G. Galvanized Metal Surfaces: Galvanized metal surfaces shall be pretreated and wiped with a biodegradable cleaner to remove any dirt, oil or grease. The galvanized surfaces shall be prepared and primed prior to application of the finish coat(s) of paint as recommended by the paint manufacturer.

1.12 WARRANTY

- A. Work performed to Specifications will be warranted as follows:
 - 1. The Paint Manufacturer warrants to the building Owner and to the Contractor that for five (5) years after the date of substantial completion for the application of all coatings scheduled in Article 3.8 "Painting Schedule", Section 09912 – Interior Painting of the project specifications and installed by the Painting Contractor, these coatings will be free from defects in manufacture and will conform to manufacturer's specifications for these products. In addition, if the Contractor applies each coating in accordance with the manufacturer's specification for application as noted below, the Paint Manufacturer warrants to the building Owner and to the Contractor that the product so applied will perform satisfactorily for three (3) years under installed conditions and will provide normal and customary protection of the substrate and will not crack, peel or blister for five (5) years under installed conditions. The warranty applies only to above-grade coated surfaces and does not apply to conditions caused by structural defect, building settlement or building movement as determined and certified by the project Structural Engineer, vandalism, negligence or other causes beyond the Paint Manufacturer's control.
 - 2. The Paint Manufacturer representative will be given full and complete access to the job site during all stages of the construction. The paint manufacturer's representative will:
 - a. Inspect all surfaces prior to paint application.

- b. Provide detailed written specifications for surface preparation, sealing, curing time, temperature, coatings specifications, or special application procedures for each scheduled coating.
 - c. Provide all reports, testing, monitoring, checking, etc. as listed in the project specification Section 09912 – Interior Painting for this project.
4. Any claim made under this warranty must be in writing within thirty (30) days of the alleged product failure. "The paint manufacturer makes no other warranties, express or implied," including without extending or limiting the duration provided by law of any implied warranty or warranty of fitness for purpose or use." In the event that the installed product fails to conform to the above warranties, written notification will be forwarded to the Paint Manufacturer as noted above.

Within thirty (30) days, a response detailing the Paint Manufacturer's analysis and recommendations including the Contractor's schedule for required remedial actions will be provided for coordination with the Architect and Owner. Any recoated areas will be warranted only for the remainder of the original warranty period, which shall not be extended as a result of the supply of replacement materials or labor.

Provide a signature element that includes the name and title of the signatories for the Paint Manufacturer, the building Owner, the Contractor, the date of substantial completion/warranty effective date, and the project name and address.

By issuing this warranty, the Paint Manufacturer and this contractor confirm that said warranty shall include and cover the Paint Manufacturer's costs relating to corrective or replacement paint, coatings or sealant work needed to re-establish the integrity of the paint for this project. This includes all labor and materials. This warranty shall apply to excessive cracking, chipping, peeling, or disbonding of the paint from any substrate. It is understood that minor fading is expected; however, any catastrophic discoloration or loss of color shall also be covered by said warranty.

1.13 MOCK-UPS

- A. Prepare a field sample application of each scheduled paint color (mock-up) at locations approved by the Architect. Each mock-up shall cover approximately 4 square feet of area (2'-0" by 2'-0"). Apply mock-ups in quantities of paint colors selected and furnished by the Owner or Architect. Upon approval of preliminary colors by the Owner and the Architect, furnish final mock-ups.
- B. At finished construction locations as directed and approved by the Architect, provide final painting field mock-ups to cover approximately 100 square feet of area (10'-0" by 10'-0") using final colors per Article 1.10 above. Mock-ups are to represent conditions of finished work including one typical horizontal to vertical interface for both interior and exterior conditions as well as typical wall surfaces.

- C. Mock-ups approved by the Owner shall constitute standard of acceptance for remaining work. Do not disturb or alter mock-ups during remaining construction.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Basis of Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The) or comparable product by one of the following:
 - 1. PPG Paints.
 - 2. Porter Paints
 - 3. Devoe/ICI Paints
- B. Manufacturers: Subject to compliance with the project requirements and specifications, provide products specified below or an Architect approved equal. The burden of proof of equality is on the proposer.
- C. Substitutions: Where a selected manufacturer or product has been specified, and equal or superior product or change in manufacturer may be accepted only upon review and written acceptance by the Architect. All such proposed changes or substitutions shall be submitted to the Architect with appropriate manufacturer's specifications and literature, environmental compliance assurance and independent laboratory testing data, and side by side comparative for each product type. The Architect's decision whether a product or manufacturer is equal or superior to the one specified shall be final. Refer to Division 01 for additional product substitution requirements.
- D. All materials used in this paint contract shall be as manufactured and delivered on the job in original, sealed containers.
- E. The paints herein specified are known to be suitable and will be enforced as the required standards of quality of this work.
- F. Extra Materials: Provide 10-gallons of each selected color for maintenance stock to the owner.
- G. Provide a final typed painting schedule to be included in Section 01700 – Project Closeout with maintenance manuals.
- H. Damp proofing to be applied to the interior face of the perimeter New exterior CMU walls (where concealed) walls are to be "Dry-Lock", or approved equal.

2.2 COLORS

- A. Colors of the interior of the project shall be as selected by the Owner and the Architect. Color schedules shall be furnished to the Applicator before application of prime coats. Prime coats will be tinted to be a slightly different shade compared to

the succeeding coat. Refer to the Drawings for the paint colors and location.

- B. Colors of the storage and mechanical rooms will be a single color; antique white or similar color based on the Airport standard to be approved by the Owner and Architect.

PART 3 EXECUTION

3.1 INSPECTION

- A. Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Painting contractor shall notify the General Contractor in writing if repair or replacement of any damaged or otherwise unacceptable substrates exist or is necessary. Verify that painting may be completed in strict accordance with the project requirements/specifications and with the manufacturer's recommendations. Do not proceed until all such discrepancies have been fully resolved.
- B. All work will be inspected and approved in writing, on a regular basis by the paint manufacturer's representative. A schedule of inspections required of the manufacturer will be reviewed and coordinated with the General Contractor prior to the commencement of the painting work.
 - 1. The minimum inspection requirements prior to start of each area or drop are:
 - a. Verify that surfaces are ready to receive work.
 - b. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
 - c. Verify that substrate moisture content and PH do not exceed recommended conditions as predetermined by all parties involved.
 - d. Examine all caulk joints for use of appropriate sealant, adequate application and adequate adhesion.
 - 2. Minimum testing during application:
 - a. Moisture.
 - b. PH test.
 - c. Wet mil test of base application.
 - d. Dry mil test of base application.

- e. Wet mil test of finish coat(s).
3. Minimum upon completion:
 - a. Dry mil test of completed application.
 - b. Summary report of all testing and copies of all field testing reports.

3.2 SURFACE PREPARATION

- A. General: Clean and prepare surfaces to be painted in accordance with manufacturer's printed instructions and current recommendations for each particular substrate condition and as specified.
 1. Notify the Architect and General Contractor in writing of problems anticipated using specified finish coat material with substrates primed by others.
 2. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and items in place that are not to be painted, or provide suitable protection prior to surface preparation and painting. Remove items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, reinstall items removed using workmen skilled in the trades involved.
 3. Clean surfaces before applying paint or surface treatment. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- B. Cementitious Surfaces: Prepare concrete, concrete masonry, and similar surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. Use abrasive blast cleaning if recommended by paint manufacturer.
 1. Determine alkalinity and moisture content of surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- C. Wood: Clean surfaces of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper as required. Sand surfaces exposed to view smooth, and dust off.
 1. Scrape and clean, small, dry, seasoned knots and apply a thick coat of white shellac or other recommended knot sealer, before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, end, faces, undersides, and backsides of wood.
 3. When transparent finish is required, use spar varnish for back priming.

4. Seal tops, bottoms, and cutouts of unprimed wood doors with heavy coat of varnish or sealer immediately upon delivery.
 5. Wood floors to receive (4) four coats of sealer; refer to specification Section - Wood Flooring for field finishing requirements. Initial coats shall be thinned for maximum penetration of sealer.
- D. Ferrous Metals: Clean non-galvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
1. Touch-up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- E. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pre-treatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- E. Doors: Door bottoms and tops shall be primed and painted prior to hanging the doors. The Contractor shall coordinate the timing of this work to ensure that this process is completed prior to hanging the doors within the frame.

3.3 GENERAL

- A. Protect work of other trades, whether to be painted or not, from damage by painting work. Mask hardware as required to protect, i.e. brass door butts, etc.
- B. Provide "Wet Paint" signs where appropriate to protect uncured finishes.
- C. Spray applications, when used, shall produce the equivalent hiding quality per coat as brush or roller-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass. All spray applied paint shall be "back rolled" to assure proper coverage and uniformity.
- D. The first and second coats of paint will be of slightly different shades for inspection purposes.
- E. Viscosity and thickness tests may be taken by the General Contractor or manufacturer. Cost of tests will be borne by the subcontractor if found to be below specification requirements.
- F. Painter to protect floors from over-spray and to clean if necessary.
- G. All weather stripping around doors, windows and other openings shall not be painted. Special care shall be taken to properly "mask" and protect these components from all painting operations.

- H. All finished drywall surfaces shall be coated with a primer/sealer to highlight any imperfection in the drywall surface, which shall be repaired before the final application of paint is applied.
- I. Subcontractor shall provide adequate painting protection for all of the trades work throughout the painting operations. Once surrounding services have been painted and protection is no longer needed, temporary protection shall be removed.
- J. Clean all surfaces of foreign matter prior to any paint application.

3.4 MATERIALS PREPARATION

- A. Mix and prepare paint in accordance with manufacturer's directions. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
- B. Use factory mixed colors, shade, and tints. Job mixing permitted only with specific written approval of the Paint Manufacturer's representative and the Architect.
- C. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.
- D. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.
- E. Use only thinners approved by manufacturer, and only within recommended limits.

3.5 APPLICATION

- A. Apply paint of consistency recommended by and in accordance with the paint manufacturer's data sheets. Use tools and techniques best suited for the substrate and type of material being applied per manufacturer's data sheets.
- B. Paint interior surfaces of ducts where visible through registers or grilles, with a flat, non-specular black paint as per paint schedule.
- C. Finish exterior and interior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.
- D. Exposed pipes and ductwork on or near walls or ceilings that are to be painted shall be painted, unless otherwise indicated.
- E. Orange peel/rough finish on metal or wood surfaces shall not be permitted.
- F. Provide primer coats for all walls and trim to receive a faux finish. Faux finishes are not included in this contract.

- G. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth, even surface, in accordance with the manufacturer's directions.
- H. Apply additional coats when undercoats show through final coat of paint, until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry-film-thickness equivalent to that of flat surfaces.
- I. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
- J. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
- K. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
- L. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- M. The back of hollow metal-exterior door frames shall be finished with a mastic primer, from the bottom of the door to 18 inches above the finish floor.
- N. Omit primer on metal surfaces that have been shop-primed and touch up painted.
- O. Sand lightly between each succeeding enamel or varnish coat.
- P. Scheduling Painting: Apply first-coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable, and before subsequent surface deterioration. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- Q. Minimum Coating Thickness: Apply materials at the manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by the manufacturer.
- R. Block Fillers: Apply block fillers to concrete masonry unit at a rate to ensure complete coverage with pores filled.

- S. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material required to be painted or finished, and has not been prime coated by others.
 - 1. Recoat primed and sealed substrates where evidence of suction spots or unsealed areas in the first coat appears, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- T. Brush Application: Brush-out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Draw neat glass lines and color breaks.
 - 1. Apply primers and first coats by brush unless manufacturer's instructions permit use of mechanical applicators.
- U. Mechanical Applications: Use mechanical methods for paint application when permitted by manufacturer's recommendation, governing ordinances, and trade union regulations.
 - 1. Wherever spray application is used, apply coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment building-up film thickness of two coats in one pass unless recommended by the manufacturer.
- V. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirement.

3.6 FIELD QUALITY CONTROL

- A. The Owner reserves the right to engage the services of an independent testing laboratory to sample and test paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.
 - 1. The testing laboratory will perform appropriate tests as required by the Owner.
 - 2. If tests show material being used does not comply with specified requirements, the Contractor may be directed to stop painting pay for testing, repaint surfaces coated with reject paint, remove rejected paint from previously painted surfaces if, upon repainting with the specified paint, the two coatings are non-compatible.

3.7 CLEAN UP AND PROTECTION

- A. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans, and rags at the end of each workday.
- B. Remove splashed, dropped, spattered, and spilled paint from hardware, fixtures, glass, and building parts.

- C. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing, or replacing, and repainting as acceptable to the Architect.
- D. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- E. At the completion of work of other trades, and after notification in writing to the Contractor, touch-up and restore all damaged or defaced painted surfaces. A touch-up allowance will be included in final contract.

3.8 PAINT SCHEDULE

3.8.1 COLOR SCHEDULE

Interior Building Colors to be selected by the Architect from manufacturer standard colors and approved by Owner.

- A. IP-1 Eggshell Finish – Front Porch SW 7651 (Accent color)
- B. IP-2 Eggshell High Performance Finish- Snow Bound SW 7004 (Base color)
- C. IP-3 Epoxy Eggshell Finish– Egret White SW 7570 (Corridor)
- D. IP-4 Epoxy Eggshell Finish– Sensible Hue SW 6198 (Toilet walls)
- E. IP-5 Flat Finish– High Reflective White SW 7757 (Ceiling rooms)
- F. IP-6 Semi-gloss High Performance Finish– (Hollow metal door/window frames)

3.8.2 PAINT SYSTEMS AND COATING SCHEDULE

Refer to the Drawings for the materials for the application of the various interior paint finish types (letter designation) scheduled below. Provide finish scheduled below if not indicated on the Drawings or Finish Schedule on the Drawings.

- A. THE SHERWIN WILLIAMS COMPANY: Attached are the Material Supplier's detailed prime and finish coats specifications. This defines primer and finish coat names, product number designations, and thickness. Because this supplier is providing a warranty, strict adherence to product Data Sheet and label instructions shall be followed. The following schedule shall not be considered as entirely inclusive, but construed as a general guide for complete painting of buildings, structures, etc., including, but not limited to, storage spaces, recesses, returns, reveals, soffits, haunches, forming part of a particular surface, room or space, pipes, conduits, duct work, panels, mechanical equipment, etc.

FINISH TYPE	Wet Film Thickness MILS	Dry Film Thickness MILS	Spread Rate SF/Gal.
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A1. Interior Concrete - Prime Only

1st coat	Sherwin Williams Loxon Concrete & Masonry Primer, A24W300			
		8.0	3.2	200

A2. Interior Concrete - Flat Finish

1st coat	Sherwin Williams Loxon Concrete & Masonry Primer, A24W300	8.0	3.2	200
2nd coat	Sherwin Williams Pro/Mar 700 Latex Flat B30W7700	4.0	1.1	300
	TOTAL DRY MILS		1.4	

A3. Interior Concrete - Semi Gloss Finish

1st coat	Sherwin Williams Loxon Concrete & Masonry Primer, A24W300	8.0	3.2	200
2nd coat	Sherwin Williams Pro/Mar 700 Latex Semi-gloss B31W7700	4.0	1.3	300
	TOTAL DRY MILS		4.5	

A4. Concrete Floor Sealer - Clear

1st coat	Concrete Sealer H & C Concrete & Masonry Waterproofing Sealer			
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B1. Interior (Face) Concrete Block - Prime Only / Exterior Walls (Dry Lock-Alternate)

1st coat	Sherwin Williams Water Blocking Primer Finish Interior Latex, B72W08010	8.0	3.7	75
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B2. Interior Concrete Block - Flat Finish

1st coat	Sherwin Williams Prep Rite Block Filler B25W25	16.0	8.0	87-108
2nd coat	Sherwin Williams Pro/Mar 700 Latex Flat B30W7700	4.0	1.1	300
	TOTAL DRY MILS		9.1	

B3. Interior Concrete Block - Semi Gloss Finish

1st coat	Sherwin Williams Prep Rite Block Filler B25W25	16.0	8.0	87-108
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2nd coat	Sherwin Williams Pro/Mar 700 Latex Semi-gloss B31W7700	4.0	1.3	300
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TOTAL DRY MILS			9.3	
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C1. Interior Gypsum Board - Prime Only

1st coat	Sherwin Williams ProMar 400 Zero VOC Int. Latex Primer, B28W04600	4.0	1.1	300
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C2. Interior Gypsum Board - Flat Finish

1st coat	Sherwin Williams ProMar 400 Zero VOC Int. Latex Primer, B28W04600	4.0	1.1	300
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2nd coat	Sherwin Williams Pro/Mar 700 Latex B28W7700	4.0	1.1	300
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3rd coat	Sherwin Williams Pro/Mar 700 Latex B28W7700	4.0	1.1	300
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TOTAL DRY MILS			3.3	
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C3. Interior Gypsum Board - Eggshell Finish

1st coat	Sherwin Williams ProMar 400 Zero VOC Int. Latex Primer, B28W04600 Build Primer B28W601	4.0	1.1	300
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2nd coat	Sherwin Williams Pro/Mar 400 Zero VOC Int. Latex Eg-Shel, B20-4600	4.0	1.3	300
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3rd coat	Sherwin Williams Pro/Mar 400 Zero VOC Int. Latex Eg-Shel, B20-4600	4.0	1.3	300
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TOTAL DRY MILS			3.7	
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C4. Interior Gypsum Walls to Receive Wallcovering

1st coat	Multi-Purpose Int/Ext Latex Primer/Sealer, B51-450 Series			
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D1. Interior Metal Doors and Frames - Prime Only

1st coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	200
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D2. Interior Metal Doors and Frames - Factory Primed

1st coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series (spot prime)	6.0	3.0	200
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2nd coat	Sherwin Williams Pro/Mar 200 Alkyd Semi-Gloss B34-200	4.0	1.7	300
3rd coat	Sherwin Williams Pro/Mar 200 Alkyd Semi-Gloss B34-200	4.0	1.7	300
TOTAL DRY MILS			6.4	

E3. Mechanical and Structural Members Exposed to view

1st coat	Sherwin Williams Macropoxy 646 Fast Cure Epoxy, B58-600 Series	7.0	5.0	136-227
2nd coat	Sherwin Williams Hi-Solids Polyurethane, B65-300 Series	4.0--8.0	3.0-5.0	215-250
TOTAL DRY MILS			8.0-10.0	

E5. Structural Steel

1st coat	Sherwin Williams Kem Kromik Universal Primer, B50 Series	6.0	3.0	274
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600 Series	6.0	2.5	200
TOTAL DRY MILS			5.5	

E6. Structural Steel Touch-Up

1st coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	300
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E7. Interior Ferrous Metal / Exposed to view Fire Sprinkler Piping

(Refer to galvanized metal surface preparation if sprinkler piping is galvanized.)

1st & 2nd coats Each Coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	200
3rd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600 Series	6.0	2.5	200
TOTAL DRY MILS			8.5	

E8. Unfinished Ferrous Metals

1st coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	200
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600 Series	6.0	2.5	200
TOTAL DRY MILS			5.5	

E9. Interior Exposed Mechanical Equipment - Shop Primed

Ferrous Metal Pretreatment: Remove all rust and mill scale prior to coating.

1st coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	200
2nd coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series	6.0	3.0	200
3rd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600 Series	6.0	2.5	200
TOTAL DRY MILS			8.5	

E10. Interior Surfaces of Ducts Where Visible Through Registers or Grilles

1st coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic, B66-560 Series Black	3.75	1.5	
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E11. Galvanized Metal

(If Galvanized Metal is Surface Treated, must Solvent Clean with Biodegradable Cleaner)

1st coat	Sherwin Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series	6.0	3.0	264
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-600 Series	6.0	2.5	

E12. Galvanized Surface touch-up

1st coat	Sherwin Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series	6.0	3.0	200
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E13. Copper Piping Exposed to view

1st coat	Sherwin Williams Multi-Purpose Int/Ext Latex Primer/Sealer, B51-450 Series	4.0	1.4	200
2nd coat	Sherwin Williams Pro Industrial High Performance Acrylic, B66-650 Series			

6.0 2.5 200

TOTAL DRY MILS 3.9

E14. Exposed (Non-copper) Piping (Except Black Mastic Drain Pipes)

1st coat Sherwin Williams Macropoxy 646 Fast Cure Epoxy, B58-600 Series 7.0 5.0 136-227

2nd coat Sherwin Williams Macropoxy 646 Fast Cure Epoxy, B58-600 Series 646 Series 7.0 5.0 136-227

3rd coat Pro Industrial High Performance Acrylic, B66-660 Series 6.0 2.5 200

TOTAL DRY MILS 12.5

E15. Unprimed Ferrous Metal and Overhead Grille Brackets

Pretreatment: Clean in accordance with Paragraph 1.11D.

1st coat Sherwin Williams Kem Kromik Universal Metal Primer B50 Series 6.0 3.0 200

2nd coat Sherwin Williams Industrial Enamel, B54 Series, Gloss Enamel Gloss 5.0 2.0 300

F1. Interior Wood Doors, Frames, and Base - Prime Only

Pretreatment: Fill all holes with Dap Fast & Final Spackle. Caulk all open joints with Sherwin Williams C1050 Acrylic Silicone Latex Caulk.

1st Coat Sherwin Williams Premium Wall & Wood Primer Int. Latex Primer, B28W8111 4.0 1.8 300

F2. Interior Wood Doors, Frames, Trim and Base – Semi-Gloss

Caulk and Putty Pretreatment: Fill all holes with Dap Fast and Final Spackle. Caulk all open joints with Sherwin Williams C1050 Acrylic Silicone Latex Caulk.

1st coat Sherwin Williams Premium Wall & Wood Primer Int. Latex Primer, B28W8111 4.0 1.8 300

2nd coat Sherwin Williams Pro/Mar 200 Alkyd Semi-Gloss B34W200 4.0 1.7 300

3rd coat Sherwin Williams Pro/Mar 200 Alkyd Semi-Gloss B34W200 4.0 1.7 300

TOTAL DRY MILS 5.2

F3. Interior Wood Stain and Sealer

1st coat	Sherwin Williams Wood Classics Interior Oil Stain, A49-200 Series	3.0-3.5	0	450-550
2nd coat	Sherwin Williams Wood Classics Polyurethane Varnish, Gloss A67V1	4.0	1.7	350-400
3rd coat	Sherwin Williams Wood Classics Polyurethane Varnish, Satin A67 Series	4.0	1.7	350-400
TOTAL DRY MILS			3.4	

* Wood floors to receive (4) four coats of sealer; refer to Section 09640 for coating requirements. Initial coats to be thinned.

F4. Terminal and Telephone Boards

1st coat	Flame Control 20-20	8.5	4.5	190
2nd coat	Flame Control 20-20	8.5	4.5	190
TOTAL DRY MILS			9.0	

G1. Interior PVC Piping Exposed to view

1st coat	Multi-Purpose Int/Ext Latex Primer/Sealer, B51-450 Series	4.0	1.4	200
2nd coat	Sherwin Williams PM 400 Zero VOC Int. Flat, B30-4600 Series	4.0	1.2	300
TOTAL DRY MILS			2.6	

S2. Interior Sealant

C-950 Acrylic Sealant

END OF SHERWIN WILLIAMS COMPANY PAINT SYSTEMS SCHEDULE

END OF SECTION 09912

SECTION 09960 – HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and painting of exterior metal tube beams and beam support columns and exterior metal components.
- B. Related Sections:
 - 1. Division 5 Section “Metal Fabrications.”
 - 2. Division 9 Section “Exterior Painting” for surface preparations, painting, and finishing of all other exposed exterior items and surfaces.

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the Steel Structures Painting Council, NACE, ICRI and the manufacturer's printed instructions.
- B. The Architect’s decision shall be final as the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.4 APPLICATOR CERTIFICATIONS

- A. The Applicator shall have five years practical experience and successful history in the application of specified products in similar projects. This requirement shall be substantiated by furnishing a list of references and job completions.
- B. Applicator must successfully demonstrate to the product manufacturer the ability to apply the material correctly and within the confines of the specifications. The Applicator must provide a letter from the manufacture stating their acceptance of the Applicator for this project to apply these products.
- C. The Applicator shall possess the applicable license to perform the work as herein described and as specified by local, state and federal laws.

1.5 QUALITY ASSURANCE

- A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application, and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Architect.
- B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces", SSPC-Vis-1 and ASTM Designation D2200; "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces" SSPC-Vis-2 and ASTM Designation D610; and ICRI CSP Surface Profile Chips.
- C. Application: No coating or paint shall be applied: When the surrounding air temperature or the temperature of the surface to be coated is below the minimum required temperature for the specified product; to wet or damp surfaces or in fog or mist; when the temperature is less than 5 degrees F. above the dewpoint; when the air temperature is expected to drop below 40 degrees F. within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. If above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.
- D. Thickness and Holiday Checking: Thickness of coatings and paint shall be checked with a non-destructive, magnetic type thickness gauge. The integrity of coated interior surfaces shall be tested with an approved inspection device. Non-destructive holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system. For thicknesses between 10 and 20 mils (250 microns and 500 microns), a non-sudsing type wetting agent, such as Kodak Photo-Flo, may be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations, and retested. No pinholes or other irregularities will be permitted in the final coating.
- E. Inspection Devices: The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce; National Bureau of Standard certified thickness calibration plates to test accuracy of dry film thickness gauges and certified instrumentation to test accuracy of holiday detectors.
- F. All necessary testing equipment shall be made available for the Architect's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Architect.

1. 6 SAFETY AND HEALTH REQUIREMENTS

- A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate

technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working on or about the project site.

- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying halfmask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminant to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Architect, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The Architect shall determine the level of illumination for inspection purposes.
- F. Confined Space: When applicable it is mandatory that all work be performed in compliance with OSHA'S rules and regulations for working in confined space. Atmospheres within confined spaces as defined by the Occupational Safety and Health Administration are classified as being either a Class A, Class B or Class C environment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Co. are listed to establish a standard of quality. Equivalent materials of other manufacturers may be substituted on written approval of the Architect.

Basis of Design: Tnemec Company, Incorporated –Florida Protective Coatings. Contact is Mr. Chad Holmes (727) 201-6706 or cholmes@tnemec.com.

Requests for substitution shall include manufacturer's literature for each product giving the name' product number, generic type, descriptive information, solids by volume, recommended dry film thickness, cost savings and certified test reports showing results to equal the performance criteria of the products specified herein. No request for substitution shall be considered that will decrease film thickness, the number of coats or offer a change in the generic type of coatings specified. In addition, a list of five similar

projects shall be submitted in which each product has been used and rendered satisfactory service.

Requests for product substitution shall be made in accordance with Division 01.

Manufacturer's color charts shall be submitted to the Architect and Owner at least 30 days prior to paint application. Contractor and painting contractor shall coordinate work so as to allow sufficient time (five to ten days) for paint to be delivered to the jobsite.

- B. All materials shall be brought to the jobsite in original, sealed containers. They shall not be used until the Architect has inspected contents and obtained data from information on containers or labels. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- C. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paint must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times, coating and paints shall be protected from freezing.
- D. A NACE certified technical representative from the paint manufacturer shall visit the job site to support the Contractor's personnel, the Owner and/or the Architect as needed and/or requested. Visits shall be made as needed to help with hold points for the Owner or Architect. Additional visit shall be made as needed and/or requested by Owner, Architect or Contractor. 48 hours' notice is required by the Contractor for each hold point inspection.
- E. All parties, to include the owner or Owner's designated representative, Architect, Contractor, installer, any subs and the product manufacture, shall meet prior to any work is started to review the spec and discuss job specific expectations, need and requirements

F. Coating Systems:

Exterior Exposed Surfaces

Structural Steel and all Misc. Metal:

Surface Preparation: SSPC-SP6/NACE 3 Commercial Blast Cleaning. The surface shall be clean and dry.

1st Coat: Tnemec Series 90-97 Tneme-Zinc @ 2.5 – 3.5 dry mils.

2nd Coat: Tnemec Series N69 Hi-Build Epoxoline II applied at 4.0 – 6.0 dry mils.

3rd Coat: Tnemec Series 740 UVX applied at 3.0 – 5.0 dry mils.

Galvanized Metal:

Surface Preparation: SSPC-SP1 Solvent Cleaning. Remove all soluble and insoluble contaminants and corrosion. Remove any storage stains per Section 6.2 of ASTM D6386. Sweep (Abrasive) Blasting per ASTM D 6386 to achieve a uniform anchor profile (1.0 - 2.0 mils).

- 1st Coat: Tnemec Series N69 Hi-Build Epoxoline II applied at 2.0 – 6.0 dry mils.
2nd Coat: Tnemec Series 740 UVX applied at 3.0 – 5.0 dry mils.

PART 3 - EXECUTION

3.1 GENERAL

- A. All surface preparation, coating and painting shall conform to applicable standards of the Steel Structures Painting Council, NACE, ICRI and the manufacturer's printed instructions. Material applied prior to approval of the surface by the Architect shall be removed and reapplied to the satisfaction of the Architect at the expense of the Contractor.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained and transfers of key personnel shall be coordinated with the Architect.
- C. The Contractor shall provide an English speaking supervisor at the work site during cleaning and application operations. The supervisor shall have the authority of sign change orders, coordinate work, and make decisions pertaining to the fulfillment of the contract.
- D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- E. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Architect.
- F. Application of the first coat shall follow immediately after surface preparation and cleaning and before rust bloom or flash rusting occurs. Any cleaned areas not receiving first coat within this period shall be re-cleaned prior to application of first coat.

3.2 SURFACE PREPARATION

- A. The latest revision of the following surface preparation specifications of the Steel Structures Painting Council and NACE shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.
 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust' loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.
 4. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed.
 5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Blast cleaning until at least 66 percent of each element of surface area is free of all visible residues.
 6. Near White Blast Cleaning (SSPC-SP10/NACE 2): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.
 7. Surface Preparation of Concrete (SSPC-SP13/NACE 6): This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
 8. Power Tool Cleaning to Bare Metal (SSPC-SP11): This standard covers the requirements for power tool cleaning to produce a bare metal surface and to retain or produce a minimum 25 micrometer (1.0 mil) surface profile. This standard is suitable where a roughened, clean, bare metal surface is required, but where abrasive blasting is not feasible or permissible.
- B. Blast cleaning for all surfaces shall be by dry method unless otherwise directed.
- C. Particle size of abrasives used in blast cleaning shall be that which will produce a 1.5 – 2.0 mil (37.5 microns - 50.0- microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.
- D. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Architect.
- E. During blast cleaning operations, caution shall be exercised to insure that surrounding existing coatings or paint are not exposed to abrasion from blast cleaning.
- F. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a

nuisance or hazard to the accomplishment of the work, the operation of the existing facilities, or nuisance to the surrounding environment.

- G. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.
- H. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Section 2.01 Paragraphs D.

3.3 APPLICATION, GENERAL

- A. Coating and paint application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting," and the manufacturer of the coating and paint materials.
- B. Thinning shall be permitted only as recommended by the manufacturer approved by the Architect, and utilizing the thinners stated in Section 2.01 Paragraphs D.
- C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- D. Protective coverings or drop cloths shall be used to protect floors, fixtures, and equipment. Care shall be exercised to prevent coatings or paint from being spattered onto surfaces that are not to be coated or painted. Surfaces from which materials cannot be removed satisfactorily shall be recoated or repainted as required to produce a finish satisfactory to the Architect.
- E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.
- F. Film thickness per coat specified in Section 2.01 Paragraphs F are minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats as to achieve the specified thickness.
- G. All material shall be applied as specified, unless approved in writing by the Architect.
- H. All welds, edges and other irregular surfaces shall receive a brush coat of the specified product prior to application of the first complete coat.

3.4 COATING SYSTEMS APPLICATION

- A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Section 2.01 Paragraphs D.

3.5 COLOR SCHEME

- A. Colors: Submittals will be made to the Architect and Owner for approval prior to application.

3.6 SOLVENT VAPOR REMOVAL

- A. Where appropriate all solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing in operating service.

3.7 CLEAN UP

- A. Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved by the Architect. Coating or paint spots and oil or stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Architect at no cost to the Owner.

3.8 WARRANTY

- A. The Contractor will warrant the work free of defects in material and workmanship for a period of one year from the acceptance of the work. At the end of one year, the Contractor will return for a one-year anniversary inspection of the work. The Contractor will correct any deficiencies found with no cost to the owner. Inspections shall be conducted in to conform to owners spec.

END OF SECTION 09960

SECTION 10155 - TOILET PARTITIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Overhead Braced and Floor Mounted Toilet Partitions and wall hung Urinary Screens in locations indicated on the Drawings.
- B. Related Sections include, but are not limited to:
 - 1. Section 05500 - Miscellaneous Metals
 - 2. Section 06100 - Rough Carpentry.
 - 3. Section 09310 - Ceramic Tile

1.3 REGULATORY REQUIREMENTS

- A. Conform to Chapter 11 of International Building Code, 2012 Edition in effect for installing work in conformance with ANSI A 117.1.

1.4 SUBMITTALS

- A. Product Data: Provide data on toilet partition and urinary screen materials, including catalog cuts of anchors, hardware, fastenings, and accessories.
- B. Shop Drawings: Indicate partition plan and elevation views, dimensions, and details of wall supports.
- C. Samples: Submit two samples 12 x 12-inches in size illustrating panel finish, color, and sheen.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide phenolic partitions that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide toilet partitions identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- B. Surface-Burning Characteristics: Provide phenolic partitions with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products when tested per ASTM E 84:
 - 1. Smoke-Developed Index: 70 or less for 3/4-inch thick and 85 or less for 1/2-inch material.
 - C. Stainless steel hardware shall comply with ASTM A 167, Type 304.
 - D. Concealed fasteners and leveling devices: galvanized steel; ASTM A 153.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver pre-finished materials to the project site in original, unopened cartons or packaging materials necessary to protect structure and finishes. Label packages clearly with manufacturer's name and item description.
 - B. Store compartment components in a vertical position with adequate support to ensure flatness and to prevent damage to pre-finished surface.
- 1.7 JOB CONDITIONS
- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
- 1.8 COORDINATION
- A. Furnish inserts and anchorages that must be built into other work for installation of toilet compartments and related items; coordinate delivery with other work to avoid delay.
- 1.9 WARRANTY
- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents, including but not limited to the Owner's warranty requirements of the Div. 0 and Div. 1 specification requirements.
 - B. Submit written agreement on toilet partition manufacturer's standard form, signed by manufacturer, installer, and contractor, agreeing to repair or replace defective parts including, but not limited to doors, panels, and hardware, that do not comply with referenced quality standards and plastic laminated materials that discolor or delaminate from the partition core.

1. Warranty Period: three years from date of Substantial Completion and Owner Final Acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Materials are specified by brand names to establish a basis for quality and design, or by performance requirements and general description of product. The Interior Designer or Architect will consider substitutions for brand names of products specified, provided the procedures set forth for substitutions are followed and the substitutions are equal or better than the approved products. The Architect reserves the right to reject any material which, in the Interior Designer's opinion, will not produce the quality of the work specified herein.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:
 1. Ampco Products Inc. (305) 821-5700 www.ampco.com
 2. Bobrick Washroom Equipment (800) 553-1600 www.bobrick.com
 3. General Partitions Mfg. (814) 833-1154 www.genpartitions.com
- C. One substitute manufacturer may be submitted for each product specified in this section, to Architect for review following procedures established in Section 01631 and upon receipt of completed Substitution Form.

2.2 PRODUCTS

- A. Panel Construction: High pressure through color scratch resistant plastic laminate, NEMA LD 3, GP-50, 0.050-inch nominal thickness, color and pattern as selected by Architect; core of 1" thick, APA-Marine-Grade Plywood (exterior grade) with fully waterproof structural adhesive. Pilaster Shoes: ASTM A 167, Type 302/304 stainless steel, not less than 3" high, 20 gage, finished to match hardware.
- B. Doors and Panels: 1 inch thick, face pressure bonded to core.
- C. Partition Mounting & Style: Standard Overhead Braced and Floor Mounted.
 1. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.
- D. Screen Mounting & Style: Continuous – Stainless Steel "C" Channel Wall-Hung.
 1. Support Brackets for Urinal Screens: Manufacturer's standard continuous stainless steel "C" channel bracket.

- E. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, ASTM A 167, Type 302/304 stainless steel, not less than 3" high, 20 gage, finished to match hardware.
- F. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.
- G. Hardware: Manufacturer's standard design, heavy-duty operating hardware and accessories of stainless steel.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees and return to pre-set position when not locked. Hinge shall allow emergency access by lifting the door from the bottom.
 - 2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 5. Door Pull: Manufacturer's heavy duty-latch-type unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

2.3 FABRICATION

- A. Fabricate components with plastic laminate finish to faces and edges of core material. Apply laminate to edges before broad surfaces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture.
- B. Doors: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments indicated to be accessible to people with disabilities unless noted otherwise on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify that opening dimensions and plumbing fixture and rough-in locations are as indicated on shop drawings and have been verified in the field.

3.2 INSTALLATION

- A. Install partition components secure, plumb, and level in accordance with manufacturer's instructions.
- B. Attached panel brackets securely using anchor devices; anchors for urinal screens shall be set to ensure lateral loads are accommodated.
- C. Provide adjustment for height variations with threaded rods through steel saddles. Conceal fastenings with pilaster shoes.
- D. Equip each door with three hinges, one door latch, and one coat hook and bumper.
- E. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10155

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SECTION 10200 - LOUVERS AND DAMPERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this section as shown, noted, detailed and reasonably implied on the Drawings and in the Specifications.
- B. Refer to Mechanical Drawings and Specifications for additional louver requirements.

1.3 RELATED 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:

1.4 SUBMITTAL DATA AND SAMPLES

- A. Submit shop drawings and product data under provisions of Section 01330 – Shop Drawings, Product Data and Samples.
- B. Shop drawings showing locations of all louvers, size, shape and gauge of metal, method of anchoring, flashing, bracing and connect to work of other trades.
- C. Draw profiles, sections, overall details, dimensions, and views of items at a scale large enough to permit checking for design conformity.
- D. Submit manufacturer's printed data describing products, specifications, and their installations.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered to the project site in their original unbroken containers, bearing manufacturer's name and brand designation and specification number.
- B. All materials shall be stored in a secured, dry and protected area, a minimum of 4 inches above concrete slab, and in accordance with Section 01600 – Materials and Equipment and Section 01620 – Storage and Protection.

1.6 DESIGN CRITERIA

- A. Comply with the International Building Code – 2012 Edition in effect and NFPA 101 – Current Edition. Nothing in this Section shall be construed as allowing or requiring noncompliance with the Code.
- B. Design wind pressures, uplift loads and design wind speed shall be per IBC.
- C. Wind pressures act perpendicular to flat surfaces, regardless of surface orientation. Wind pressures act perpendicular to tangents of curved surfaces. At corners and changes in plane, adjacent surfaces shall be assumed to experience the worst case combination of inward pressure simultaneously, outward pressure simultaneously, and simultaneous occurrence of inward pressure on one surface and outward pressure on adjoining surface.

1.7 WARRANTY

- A. Refer to Section 01770 - Closeout Procedures, Detail Requirements and Section 01740 Warranties and Bonds.
- B. Louver manufacturer shall supply in writing, at job completion, a ten (10) year warranty against failure of the powder coat finish, Powder Coat complying with AAMA 2604.criteria finish.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The basis of design is Extruded Drainable Blade Louvers and Counterbalanced Relief Dampers (where scheduled) as manufactured by Greenheck .
- B. Equivalent products manufactured by Airolite, Mestec Louver Group, Ruskin Louver Co. or approved equal are acceptable.
- C. Refer to the Drawings for the Louver sizes and dimensions.

2.2 ALUMINUM LOUVERS - EXTERIOR

- A. Exterior louvers shall be Greenheck Model No. EHV-901D Dual Module Louvers, 9 inches deep, fixed blades at 45-degree angle at 6" o.c. spacing. 54% free area and class A wind driven rain classification.
- B. Aluminum shall be 6063-T5 extruded.
- C. Blades: Minimum 0.125 inches thick by 6 inches deep; louver blade to frame connections shall be both mechanically fastened with 300 series stainless steel threaded fasteners and welded.
- D. Jambs: Minimum 0.125 inches (8 gauge) thick.
- E. All vertical mullions shall be the exposed type to provide for drainage of water from the blades to the louver sill.

- F. Fasteners: Spacing and size per manufacturer, as required to meet required wind loads.

2.3 ACCESSORIES

- A. All exterior louvers shall receive an extruded bird screen frame with 1/2 inch mesh, 0.063 inch wire diameter of aluminum material.
- B. Extruded aluminum sill extension, extension length as to match assembly width.
- C. Furnish and install aluminum subsill flashings and gutter system with end dams, set in full bed of sealant, at louver base. Minimum 12 gauge, color to match louver.

2.4 LOUVER AND DAMPER SIZES AND LOCATION

- A. Louver sizes as required for ventilation and mechanical systems.

2.5 FASTENERS

- A. Fasteners of sizes required by paragraph 1.6 D. above, shall be stainless steel Type 300 Series.

2.6 FINISHES: LOUVERS AND DAMPERS

- A. Aluminum louvers, dampers, and accessories shall be finished with manufacture's standard ten (10) year warranty powder coating that meets or exceeds AAMA 2604 criteria of custom color to match the building exterior or interior as selected by the Architect.

2.7 FINISHES: STEEL SUPPORTS

- A. All steel supports shall be hot-dipped galvanized and shall be painted per Section 09900 - Painting, colors as selected by the Architect.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. All items in this Section shall be installed by experienced skilled mechanics in the best workmanlike manner of the trade's best standard practice.
- B. All items shall be installed true, level, plumb, and in strict accordance with the manufacturer's printed instructions and approved submittals.

3.2 INSTALLATION

- A. Aluminum exterior and interior louvers and dampers shall be installed with stainless steel fasteners and/or anchors.
- B. Where aluminum is placed in contact with dissimilar materials, the aluminum shall

be back-painted before erection with zinc chromate paint or bituminous coating.

- C. After erection, the Contractor shall adequately protect exposed portions of louvers from damage by stucco, lime, cement, welding, or other harmful compounds.
- D. All exposed surfaces shall be free from scratches and other serious surface blemishes.

3.3 CLEANING

- A. The Contractor shall be responsible for removal of protective materials and subsequent cleaning. The Contractor shall be held responsible for damages resulting from the use of cleaning materials.

3.4 MATERIALS AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at no extra cost to the Owner.

END OF SECTION 10200

SECTION 10426 - BUILDING SIGNAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Furnish all labor, materials, tools, equipment, etc. and services necessary and incidental to the complete fabrication, furnishing and erection of this Section as shown, noted, detailed and reasonably implied on the drawings and in the specifications.
- B. The scope of work included in this Section is as follows:
 - 1. Interior and Exterior Building Signs (Owner required, and Code required).

1.3 RELATED SECTIONS

- A. Coordinate work of this Section with of other Sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other Sections, including:
 - 1. Division 15 – Mechanical & Plumbing. Equipment labeling.
 - 2. Division 16 – Electrical. Illuminated exit signs and equipment labeling.

1.4 REFERENCES

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
 - i. American National Standards Institute (ANSI)
 - ii. American Society for Testing & Materials (ASTM)
 - iii. Federal Specifications
 - iv. Uniform Sign Code

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300 – Shop Drawings, Product Data and Samples.
- B. Submit manufacturer's printed data describing products, model or series numbers, colors for selection, and finishes of all items in this Section.

1. Samples for Initial Selection: For each sign type and for each color and texture required, for each type of sign material indicated that involves color selection.
- C. Submit shop drawings of all items, showing locations, sizes, quantities, methods of supporting, methods of anchoring, markings, finishes and operating hardware.
 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 2. Provide message list, timesteps, graphic elements, including tactile characters and Braille, and layout for each sign.
- D. Submit samples of all signs for review, For each type of sign, include the following Samples to verify color selected:
 1. Panel Signs: Full-size Samples of each type of sign required.
 2. Approved samples will be returned for installation into Project.
- E. Submit two (2) complete building signage schedules for review. After review, provide four (4) corrected copies of this schedule for distribution. No factory order shall be placed for materials until this review process has been completed.
- F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.6 DELIVERY AND STORAGE

- A. Deliver products to site under provisions of Section 01600 – Materials and Equipment.
- B. All materials under this Section shall be delivered to the project site in their original unbroken containers bearing the manufacturer's name, brand and specification designation.
- C. All materials shall be stored in a dry, protected area and above floor level.

1.7 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
 1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices and coordinate blocking requirements.
 2. Field verify dimensions and existing conditions affecting sign installation.

1.8 CODES

- A. All signage shall conform to the Department of Community Affairs, International Building Code 2012 Edition in effect (IBC), and other governing local codes. Signage shall conform to ICC/ANSI A117.1, American National Standard for Accessible and Usable Buildings and Facilities.

1.9 WARRANTY

- A. This manufacturer shall warranty against defects in materials and workmanship for a period of one (1) year from the date of substantial completion of the building.
- B. Refer to Section - 01700 Project Closeout, Detail Requirements.

1.10 QUALITY ASSURANCE

- A. All interior signage in this Section shall be fabricated by a single manufacturer with experience in providing work similar to that specified.
- B. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1
- C. The materials used shall have flammability and smoke values that meet the standards for flammability for interior materials.
- D. Source Limitations: Obtain each sign type through one source from a single manufacturer.

PART 2 – PRODUCTS

2.1 BUILDING SIGNAGE

- A. Building signage includes, but is not limited to: Code Required life safety signage and handicapped accessibility signage, room and/or room identification, Way finding/directional signage, and general informational signage. Room identification signage shall be identified by room number only; room names are not required unless the room is along a public space or hallway.

2.2 SIGN TYPE - CODE REQUIRED & ROOM IDENTIFICATION SIGNAGE

- A. Code required signage, products produced by 2/90 Sign Systms, PH (800) 777-4310, as the Project Basis of Design, shall be two toned acrylic plastic, embossed ADA, wall or door mounted, with tactile and braille graphics, or equal as approved by the Architect or Owner. The room identification signs shall match the graphics and colors of the room identification signs at selected and approved by the Owner.

- 1. Coordinate with the Owner and the Architect for mounting locations before

- anchorage to finished substrate.
2. Characters and background of all signs shall have eggshell, non-glare finish. Braille characters shall be same color as background.
 3. Sign edges shall be smooth and free of saw marks and imperfections. The corners of the sign shall be square.
 4. Mount signs with manufacturer's suggested permanent type mounting. Do not use double-sided vinyl tape.
 5. The following manufacturers shall be considered as comparable products.
 - a. Mohawk
 - b. Andco Industries Corp.
 - c. Best Manufacturing Co.
 - d. The Super-sine Company
 - e. ASI
- G. Graphic Content and Style: Provide sign copy that complies with requirements for size, style, spacing, content, mounting height and location.
1. Type style shall be "OPTIMA," upper case (or Font to match the building standard), minimum 5/8 inch high. Lettering shall be computer generated, accurately reproducing the letter form.
 2. All letters, numbers, and/or symbols shall contrast with the background, either light characters on a dark background or dark characters on a light background. Characters and background will have a non-glare finish.
 3. Signage copy shall be accompanied by Grade 2 Braille. Braille shall be separated 12 mm (0.5-inch) from the corresponding raised character symbols. Grade 2 Braille translation to be provided by signage manufacturer.
 4. Copy Position: As indicated on drawings, or where not indicated, centered/centered (cc) within the limits of the sign.
 5. Text Height: As indicated on drawings or in signage schedule, or as follows:
 - a. Lettering for room numbers shall be 25 mm (1-inch).
 - b. Lettering for room ID signs shall be 16 mm (5/8-inch) or as noted.
 - c. Lettering height for way finding signage shall be as per the Drawings.
 6. Where graphic pictograms are indicated, symbol size shall be nominal 100 mm (4-inch) diameter.
- H. Changeable Message Inserts: Provide changeable signs at all meeting rooms. Fabricate signs to allow insertion of changeable messages in the form of "IN-USE" slide-in inserts.

- I. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Panel Material: Opaque acrylic sheet or Photopolymer.
 - 2. Raised-Copy Thickness: Not less than 0.8 mm (1/32 inch).
- J. Laminated Interior Signs: Solid phenolic panel core with graphic image covered with thermosetting resin face layer.
 - 1. Surface Finish: Mat.
 - 2. Edge Condition: Manufactured standard.
 - 3. Corner Condition: small radius.
 - 4. Thickness: 3 mm (1/8 inch).

2.3 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- B. Fasteners anchored o aluminum substances or framing shall be stainless steel.

2.4 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.5 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

2.6 PIN MOUNTED SIGNAGE

- A. Aluminum 316, pin letters and graphic/logo, min. 3/8 inch thick, pin mounted, Kynar coated paint; font and custom logo as shown on the drawings; color to match the Airport campus standard.

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 work.
- B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at the elevations indicated or that may be required to comply with Authorities Having Jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. The Architect and Owner shall have final decision on the location of all items in this Section.
- B. After erection, the General Contractor shall adequately protect exposed portions of signage from damage by stucco, lime, cement, or other harmful compounds.
- C. Do not mount signage on face of doors.

3.3 INSPECTION

- A. Inspect building areas prior to sign(s) installation. Do not install signs until surfaces are acceptable to installer.
- B. Notify the Architect and Owner, in writing, if there are any questions as to suitability of sign(s), installation location(s), or surface(s).
- C. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 75

mm (3 inches) of sign without encountering protruding objects or standing within swing of door.

- D. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 2. Shim Plate Mounting: Provide 3-mm- (1/8-inch-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 - 3. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

3.4 SIGNAGE SCHEDULE

- A. A Signage Schedule shall be provided by the signage contractor per Article 1.4 Submittals, of this Section.

3.5 EXECUTION

- A. All items in this Section shall be installed by experienced skilled mechanics in the best workmanlike manner of the trade's best standard practice.
- B. All items shall be installed true, level, plumb and in strict accordance with the manufacturer's printed instructions and approved submittals.

3.6 GENERAL SIGNAGE

- A. Wall mounted signs shall be installed 60 inches above finished floor to centerline of sign, and generally on latch side of door. Location shall be such that a person may approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Signs shall not be installed on the door.

3.7 CLEANING

- A. The General Contractor shall be responsible for removal of protective materials and cleaning as recommended by manufacturer. The General Contractor shall be held responsible for damages resulting from the use of other cleaning materials.

3.8 MATERIAL AND WORKMANSHIP

- A. All damaged material and faulty workmanship shall be removed and be replaced with new material in the best workmanlike manner at no extra cost to the Owner.

END OF SECTION 10426

SECTION 10520 – FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers and mounting brackets for wall-hung fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 3. Portable Fire Extinguishers.
 - 4. Portable Fire Extinguishers Mounting Brackets.
 - 5. AED Equipment Cabinet.

1.3 SUBMITIALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Operation and Maintenance Data: For fire extinguishers and cabinets to include in maintenance manuals.
- C. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

- B. Size Limitations: Provide fire-protection cabinets having dimensions that match or are less than the width, depth and projection from wall dimensions of the specified cabinets.
- C. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- D. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- E. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and location of fire-protection cabinets with wall depths.

1.6 SEQUENCING

- A. Apply labels/lettering on field-painted fire-protection cabinets after painting is complete.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CABINET MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209.
 - 2. Extruded Shapes: ASTM B 221.
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 MANUFACTURERS

- A. Basis of Design: J. L. Industries model # C1027V10 or # FX C1027V10 (rated walls) semi recessed, powder coated-painted steel 1 and ½” radiused trim (white), contemporary vertical duo – door style, with clear tempered glass, and Futura Embossed “Fire” Handle – Mill finish, with aluminum tub and integral lock, or approved equal by Architect. Furnish and install tamper resistant break away cables.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. J.L. Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Potter-Roemer; Div. of Smith Industries, Inc.

2.3 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or black baked-enamel finish.
 - 1. Provide brackets for extinguishers not located in cabinets.
 - 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - 3. Lettered Door Handle: One-piece, cast-iron door handle with the word “FIRE” embossed into face.
 - 4. Door Lock: Cylinder Lock, keyed alike to other cabinets and facility standard.
 - 5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words “FIRE EXTINGUISERS”.
 - i. Location: Applied to cabinet door.
 - ii. Application Process: Silk-screened.
 - iii. Lettering Color: Red.
 - iv. Orientation: Vertical.

2.4 CABINET FABRICATION

- A. Non-rated Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
- B. Rated Fire Protection Cabinets (where mounted in rated walls): Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8 inch thick,

- fire-barrier material. Provide factory-drilled mounting holes.
- 2. Provide with rating to match wall rating within which cabinet is to be installed.

C. Cabinet Doors: Fabricate doors according to manufacturer's standards, from material indicated and coordinated with cabinet types and trim styles selected.

- 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
- 2. Miter and weld perimeter door frames.
- 3. Continuous hinge.

D. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

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

2.6 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No.1, "White Metal Blast Cleaning" or SSPCSP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Factory Prime chromate-free, pretreatment. Finish: Apply manufacturer's standard, fast-curing, lead- and universal primer immediately after surface preparation and
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: Matte white.

2.7 AED CABINET

- 1. AED equipment and AED training provided by Owner.
- 2. Cabinet Type Basis of Design: JL Industries or Architect approved equal: Semi-recessed with 2 1/2" rolled edge, powder coated aluminum - (white) – Model No. 1427F12.

2.8 PORTABLE FIRE EXTINGUISHERS

A. Manufacturers:

1. General Fire Extinguisher Corporation.
2. JL Industries, Inc.
3. Larsen's Manufacturing Company.
4. Potter Roemer; Div. of Smith Industries, Inc.

B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix b and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

C. Regular Dry-Chemical Type in Steel Container: UL-rated, 10 B:C, 5-lb nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container. Provide with recessed cabinets at locations shown on the drawings

D. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. Provide (3) with bracket mounts to be used at non-public spaces such as mechanical equipment rooms.

2.9 MOUNTING BRACKETS

A. Manufacturers:

1. Amerex Corporation.
2. Ansul Incorporated.
3. Badger Fire Protection.
4. Buckeye Fire Equipment Company.
5. Fire End & Croker Corporation.
6. General Fire Extinguisher Corporation.
7. JL Industries, Inc.
8. Larsen's Manufacturing Company.
9. Potter Roemer; Division of Smith Industries, Inc.

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

1. Color: Black.

C. Identification: Lettering complying with authorizes having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets are to be installed.
 - 1. Rated Partitions and Barriers: Examine to confirm construction meets rating requirements and is routed continuously "floor to ceiling." Notify Architect if partition/barrier rating will be compromised by cabinet installation.
- C. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style. Coordinate and verify depth of recess required during framing and rough in of walls.

3.3 INSTALLATION

- A. General: Install fire protection cabinets and fire extinguishers in locations.
 - 1. Comply with ADA Guidelines' "reach range" dimensions for maximum mounting heights of cabinets, extinguishers, and other emergency equipment.
 - 2. Coordinate door handle height and cabinet mounting height where cabinets are mounted with non standard manufacture heights.
- B. Fire Protection Cabinets: Fasten cabinets to structure and framing, square and plumb provide required blocking to support cabinet and fire extinguisher.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed, provide semi-recessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Apply labels/lettering at locations indicated.
- D. Examine walls and partitions for suitable framing depth and blocking where

recessed cabinets will be installed.

- E. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to Authorities Having Jurisdiction.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturers written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10520

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SECTION 10801 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet and bath accessories.
 - 2. Childcare accessories.
 - 3. Under lavatory guards.
 - 4. Custodial accessories.
- B. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- C. Related Sections:
 - 1. Division 5 Section "Metal Fabrications" for corner guards.
 - 2. Division 6 Section "Miscellaneous Carpentry" for wood blocking.
 - 3. Division 8 Section "Mirrors" for frameless mirrors.
 - 4. Division 9 Section "Ceramic Tile" for ceramic toilet and bath accessories.
 - 5. Division 10 Section "Toilet Compartments" for plastic laminate units.

1.3 QUALITY ASSURANCE

- A. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
 - 1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged by Architect and Owner, may be provided.
 - 2. Do not modify aesthetic effects, as judged by Architect and Owner. Where modifications are proposed, submit comprehensive explanatory data to Architect and Owner for review.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual toilet and bath accessory, and finishes for each toilet and bath accessory.
- B. Toilet and Bath Accessory Schedule: For toilet and bath accessories; use same designations indicated on Drawings or Schedule as specified.

- C. Maintenance Data: For each product to include in maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- C. Field verify depths of wall cavities, mounting heights, blocking requirements, locations do not interfere with door swings or use of accessory, etc. for all accessories.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
 - 1. Toilet, Bath, and Custodial Accessories:
 - a. Basis-of-Design shall be Bobrick Washroom Equipment, Inc.
 - b. The following manufacturers shall be acceptable provided products meet or exceed the specified or scheduled accessories; and are approved by the Architect and Owner:
 - 1) American Specialties, Inc.
 - 2) Bradley Corporation.
 - 3) GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 2. Childcare Accessories:

- a. Basis-of-Design shall be Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
- b. The following manufacturers shall be acceptable provided products meet or exceed the specified or scheduled accessories; and are approved by the Design Build Architect:
 - 1) American Specialties, Inc.
 - 2) Diaper Deck & Company, Inc.
 - 3) GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

- B. Products: Subject to compliance with requirements, provide products indicated for each designation in the Toilet and Childcare Accessory Schedule at the end of Part 3 or equal approved by the Architect and Owner.

2.2 MATERIALS

A. Metals

1. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.
2. Galvanized Steel Sheet: ASTM A 653/A 653M, G60

- B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

C. Accessories:

1. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
2. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
3. Blocking: Fire retardant or galvanized metal blocking (12 GA) where scheduled or required to support accessory.

2.3 FABRICATION

- A. General: One, maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

- C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.
- D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - 1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
- F. Toilet Paper Spindles/Dispensers: All Toilet paper dispensers shall be provided with spindles to accommodate coreless toilet paper rolls; 1-inch minimum diameter. Confirm size of spindle with the Airport prior to ordering materials. Provide left hand or right-hand dispensers depending on toilet configuration and orientation. Through partition units only serving one toilet compartment or stall shall be provided with a solid door panel on the adjacent stall, where no dispenser is required.
- G. Paper Towel Dispensers/Guides: Shall be provided with custom plastic guide inserts to prevent multiple paper towel dispensing at each use. The paper towel and mirror units shall be back lit and custom fabricated to match the design and as shown or scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated. Confirm clearances, wall depths, and blocking requirements prior to framing walls. Comply with FBC Accessibility mounting height and spacing requirements.
- B. Furnish and install the left-hand toilet paper and toilet seat dispenser unit at left hand configured toilets and the right-hand unit at right hand configured toilets. Provide solid face doors at single-through wall-unit applications, where only one toilet compartment requires a dispenser. The dispensers shall be flush with the partition at toilet stalls with grab bars. Ensure that the doors to service the units can open when installed and not in conflict with toilet fixtures.
- C. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

- D. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446. Install shower seats to withstand a downward load of at least 360 Lbs.
- E. Under lavatory Guards: Where this designation is indicated at all exposed plumbing pipe locations and/or where needed to prevent direct contact with and burn from piping, provide under lavatory guards complying with the following:
 - 1. Manufacturers: Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro by IPS Corporation.
 - 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 3. Material and Finish: Antimicrobial, molded plastic, white.
 - 4. Refer to plumbing fixture schedule for sinks with ceramic or porcelain shrouds.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

- A. **Solid Surface Sink: (A01)**, custom integral sink with counter
 - 1. Products: Available products include the following:
 - a. Product: Corian Undermount Solid Surface Sink
- B. **Mirror: (A02)** provide mirror unit (at all counter sinks locations) complying with the following:
 - 1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Custom (by mirror size 24 inches wide by 36 inches high) framed-hinged mirror.
 - 2. Stainless Steel, Welded-frame-beveled edge Mirror: Fabricate frame from stainless-steel angles in manufacturer's standard satin finish with corners welded, beveled edge ground and polished smooth.

- C. **Sloan Soap Dispenser: (A03)**, mount at ADA sink and counter (typ).
1. Products: Available products include the following:
 - a. Manufacturer: Sloan.
 - b. Product: Sloan model SJS-1750.
- D. **Counter Top: (A04)**, Solid surface countertop.
1. Products: Corian Solid Surface Counter top.
- E. **Combination Recessed Towel Dispenser / Waste Receptacle: (A05)**, provide combination paper towel dispenser/waste receptacle complying with the following:
1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Model B-4369 Recessed Paper Towel Dispenser and Waste Receptacle.
 2. Mounting: Recessed.
 3. Minimum Towel-Dispenser Capacity: 600 C-fold, 800 multifold, or 1100 single fold paper towels.
 4. Minimum Waste-Receptacle Capacity: 12 gal.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 6. Waste-Container: Removable, leakproof, rigid molded plastic.
 7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- F. **Toilet Partition: (A06)**
1. Products: Plastic Laminate with marine grade plywood core, reference Toilet Compartment Specifications:
- G. **Coat Hook: (A07)**, provide coat hook with bumper (at restroom toilet stalls and unisex or accessible restrooms) complying with the following:
1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Model B-6717
 2. Description: Surface-mounted stainless-steel hook.
 3. Materials and Finish: Stainless steel with satin finish.
- H. **Toilet Paper and Seat Cover Dispenser: (A08)**, provide recessed dispenser (at wall locations) complying with the following:
1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.

- b. Product: Model B-3471/B-3571 Stainless Steel Toilet Seat Cover Dispenser. Provide napkin disposal for women's restroom.
 2. Description: Partition Surface Mounting. Recessed Wall Mounted.
 3. Minimum Capacity: 250.
 4. Material and Finish: Stainless steel, No. 4 finish (satin).
 5. Mounting height: 48" max AFF mounting height. ADA stalls require accessible clear floor area. Do not obstruct required grab bar clearances.
 6. Description: Roll-in-reserve dispenser with a flush tumbler lockset.
 7. Operation: Spindles (2) – heavy-duty, 1" diameter for coreless toilet paper one-piece, molded ABS. Theft-resistant. Retained in dispensing mechanism when door is locked.
 8. Capacity: Unit holds two standard toilet tissue rolls up to 5-1/4" diameter.
 9. Provide left- or right-handed unit based on orientation.
- I. **Baby Changing Station: (A09)**, provide recessed wall mounted baby changing tables
 1. Reference 3.4 below.
- J. **ADA Floor Mounted Toilet: (A10)**
 1. Products: Reference Plumbing Drawings.
- K. **Floor Mounted Toilet: (A11)**
 1. Products: Reference Plumbing Drawings.
- L. **ADA Urinal: (A12)**
 1. Products: Reference Plumbing Drawings.
- M. **Mop Sink: (A13)**
 1. Products: Reference Plumbing
- N. **Mop Rack and Utility Shelf: (A14)**
 1. Products: Reference 3.5 below.
- O. **Door Bumper: (A15)**
 1. Products: Available products include the following:
 - a. Manufacturer: Jacknob Corporation.
 2. Product: Jacknob 4151.
 3. Finish: Stainless steel (satin).
- P. **Sanitary Napkin Vendor: (A16)**, provide sanitary napkin vendor (at all women's restrooms) complying with the following:
 1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.

b. Product: Model B-37063-50 TrimLineSeries Fully-Recessed Napkin/Tampon Vendor. ADA compliant with push button operation.

2. Mounting: Fully recessed.
3. Operation: 50 cents charge; to be confirmed with Owner
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type with separate lock and key for coin box.
6. Refill: Top-fill.

Q. ADA Apron: (A17)

1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Model B-634

R. Hand Sanitizers (A18)

1. Provided by Owner

S. ADA Grab Bars (A19)

1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Model B-5806.99 x 24" and B-5806.99 x 36"
2. Mounting: As indicated on drawings.

T. Drinking Fountain (Hi-Lo) (A20)

1. Products: Reference Plumbing Drawings.

3.4 Use CHILDCARE ACCESSORY SCHEDULE

A. Diaper-Changing Station: (A09), provide diaper-changing station (Public ADA accessible toilets) complying with the following:

1. Products: Available products include the following:
 - a. Manufacturer: Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
 - b. Product: Model K110-SSRE Horizontal Wall-Mounted Stainless-Steel Finish Baby Changing Station.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
3. Mounting: Recessed mounted, flush with wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color.
6. Liner Dispenser: Built in.
7. Comply with all ADA accessibility clearance and approach requirements.

3.5 CUSTODIAL ACCESSORY SCHEDULE

- A. **Utility Shelf With Mop and Broom Holders: (A14)**, provide utility shelf with mop and broom holder (at all janitor's closets with a mop sink) complying with the following:
1. Products: Available products include the following:
 - a. Manufacturer: Bobrick Washroom Equipment, Inc.
 - b. Product: Model B-224x36 Utility Shelf With Mop/Broom Holders and Rag Hooks.
 2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 3. Length: 36 inches.
 4. Hooks: Three.

3.6 HAND SANITIZERS

- A. Furnished by Owner; installed by General Contractor to meet ADA requirements; align with top of light switch.

END OF SECTION 10801

SECTION 12491 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Horizontal louver blinds with aluminum slats.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds based on field verified window opening dimensions.
- C. Samples for Verification: For each type and color of horizontal louver blind indicated.
 - 1. Slat: Not less than 12 inches long, color to be selected by Architect from manufacturers full range of colors and finishes.
 - 2. Color samples.
- D. Window Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.
- E. Product Certificates: For each type of horizontal louver blind, signed by product manufacturer.
- F. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to

authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Flame-Resistance Ratings: Passes NFPA 701.

C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 5 percent of amount installed, but no fewer than 4 units.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Hunter Douglas; Décor.
2. Levolor, a Newell Rubbermaid Company; Riviera.
3. Springs Window Fashions Division, Inc.; Graber; Performance Series.

- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
 - 1. Width: 1 inch.
 - a. Spacing: Manufacturers Standard.
 - 2. Thickness: Manufacturer's standard.
 - 3. Finish: One color.
 - a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:
 - 1. Capacity: One blind per headrail.
 - 2. Light-blocking lower back lip.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat and bottom contoured for minimizing light gaps; with enclosed ladders and tapes to prevent contact with sill.
- E. Ladders: Evenly spaced to prevent long-term slat sag.
 - 1. For Blinds with Nominal Slat Width 1 Inch or Less: Braided string.
- F. Lift Cords: Manufacturer's standard.
- G. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod, and the following:
 - 1. Tilt Operation: Manual with clear plastic wand.
 - 2. Length of Tilt Control: Length required to make operation convenient from floor level.
 - 3. Tilt: Full.
- H. Lift Operation: Manual, top-locking cord lock; locks pull cord to stop blind in either fully opened or fully closed position only and is equipped with a ring pull not more than 4 inches long.
- I. Valance: Two slats.
 - 1. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats.
- J. Mounting: Ceiling mounting, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.
- K. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.2 HORIZONTAL LOUVER BLIND FABRICATION

- A. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F :
1. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.
- D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- E. Color-Coated Finish:
1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 2 inches to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.
- B. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12491

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SECTION 13341 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes metal building systems that consist of integrated sets of mutually dependent components including structural framing, roof panels, wall panels, soffit panels, doors and accessories.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for concrete foundations, slabs, and anchor-bolt installation.
 - 2. Division 7 Section "Building Insulation" for insulation installed in metal roof and wall panel assemblies and "Caulking and Sealants".
 - 3. Division 8 Section for "Metal Doors and Frames" and "Overhead Rolling Doors"
 - 4. Division 9 painting Sections for finish painting of shop-primed structural framing and "Gypsum Board Assemblies".
 - 5. Division 10 Section for "Louvers and Dampers".

1.3 DEFINITIONS

- A. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.
- B. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).
- C. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).
- D. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).
- E. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).

- F. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.
- G. Terminology Standard: Refer to MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SYSTEM DESCRIPTION

- A. General: Provide a complete engineered, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.
 - 1. Provide metal building system of size and with spacing's, slopes, and spans indicated.
 - 2. Provide metal framing of size and spacing's, spans required for hangar door assembly and installation.
 - 3. Provide sub framing and blocking required for door, window louvers, signage or other exterior mounted building components.
- B. Primary Frame Type:
 - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- D. Secondary Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings. Manufacturer's standard spacing, as indicated.
- F. Bay Spacing: By nominal bay spacing on drawings.
- G. Roof Slope: 1 inch per 12 inches, U.O.N.
- H. Roof System: Manufacturer's standard vertical-rib, standing-seam metal roof panels.
- I. Exterior Wall System: Manufacturer's standard field-assembled, metal wall panels, with field installed insulation.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Engineer metal building systems according to procedures in MBMA's "Metal Building Systems Manual."
 2. Design Loads: As required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures." And the Florida Building Code latest edition in effect and the local Authorities Having Jurisdiction.
 3. Live Loads: Include vertical loads induced by the building occupancy indicated on Drawings. Include loads induced by maintenance workers, materials, and equipment for roof live loads.
 - a. Building Occupancy: As indicated on drawings.
 4. Wind Loads: Include horizontal loads induced by a basic wind speed corresponding to a 50-year, mean-recurrence interval at Project site.
 5. Collateral Loads: Include additional dead loads other than the weight of metal building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings, minimum 7 pounds per square foot.
 6. Auxiliary Loads: Include dynamic live loads, such as those generated by cranes and materials-handling equipment indicated on Drawings.
 7. Load Combinations: Design metal building systems to withstand the most critical effects of load factors and load combinations as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures." And with the 2006 International Building Code.
 8. Deflection Limits: Engineer assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
 - b. Girts: Horizontal deflection of 1/240 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/180 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
 9. Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
 10. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E 1592.
- B. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- C. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft..
- D. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at static-air-pressure difference of 6.24 lbf/sq. ft..
- E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft..
- F. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft..
- G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

1.6 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal building system components:
 - 1. Structural-framing system and engineered bracing and erection drawings.
 - 2. Metal roof panels.
 - 3. Metal wall panels and metal liner panels.
 - 4. Insulation and vapor retarders.
 - 5. Flashing and trim.
 - 6. Doors.
 - 7. Accessories.
 - 8. Windows.
 - 9. Louvers.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation, licensed in the State of the metal building installation.
 - 2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
 - 3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - 4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel

profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

- a. Show roof-mounted items including equipment supports, pipe supports and penetrations, lighting fixtures, skylights, roof vents, and items mounted on roof curbs.
 - b. Show wall-mounted items including doors, louvers, and lighting fixtures.
 - c. Show translucent panels.
5. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
- a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Roof ventilators.
 - e. Louvers.
 - f. Service walkways.
 - g. Windows and doors.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below.
1. Metal Roof and Wall Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
- D. Product Certificates: For each type of metal building system, signed by product manufacturer.
1. Letter of Design Certification: Signed and sealed by a qualified professional engineer licensed in the State of the metal building installation. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, deflection, wind loads/speeds and exposure and auxiliary loads (cranes).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.

- E. Welding certificates.
- F. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.
- G. Manufacturer Certificate: Signed by manufacturer certifying that products comply with requirements.
- H. Qualification Data: For Erector manufacturer professional engineer.
- I. Material Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Non-shrink grout.
- J. Source quality-control test reports.
- K. Field quality-control test reports.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor retarders. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- M. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.
- N. Warranties: Special warranties specified in this Section.
- O. Other Action Submittals:
 - 1. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 - a. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - b. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
 - 2. Refer to Section "Metal Doors and Frames" for specific project requirements.

1.7 QUALITY ASSURANCE

- A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain primary metal building system components, including structural framing and metal panel assemblies, through one source from a single manufacturer.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal building system and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- G. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- H. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.
- I. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Combustion Characteristics: ASTM E 136.
 - 2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - 3. Metal panels shall be identified with appropriate markings of applicable testing and inspecting agency.

- J. Surface-Burning Characteristics: Provide field-insulated metal panels having thermal insulation and vapor-retarder-facing materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less, unless otherwise indicated.
 2. Smoke-Developed Index: 450 or less, unless otherwise indicated.
- K. Pre-Erection Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal building systems including, but not limited to, the following:
1. Inspect and discuss condition of foundations and other preparatory work performed by other trades.
 2. Review structural load limitations.
 3. Review and finalize construction schedule and verify availability of materials, Erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review required testing, inspecting, and certifying procedures.
 5. Review weather and forecasted weather conditions and procedures for unfavorable conditions.
- L. Pre-installation Roof Assembly Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
1. Examine purlin and rafter conditions for compliance with requirements, including flatness and attachment to structural members.
 2. Review structural limitations of purlins and rafters during and after roofing.
 3. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 4. Review temporary protection requirements for metal roof panel assembly during and after installation.
 5. Review roof observation and repair procedures after metal roof panel installation.
- M. Pre-installation Wall Assembly Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
1. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 2. Review structural limitations of girts and columns during and after wall panel installation.
 3. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 4. Review temporary protection requirements for metal wall panel assembly during and after installation.

5. Review wall observation and repair procedures after metal wall panel installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
 2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- B. Coordinate installation of roof curbs equipment supports and roof penetrations, per the drawings or scheduled or scheduled or specified elsewhere.
- C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam, metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 3. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Buildings Company.
 2. Butler Manufacturing Company.
 3. Pinnacle Structures, Inc.
 4. Ceco Building Systems; Division of Robertson-Ceco Corporation.
 5. Gulf States Manufacturers, Inc.
 6. Metallic Metal Building Company; Division of NCI Building Systems, LLP.
 7. VP Buildings, Inc.; a United Dominion Company.
 8. Nucor Building Systems Group.

2.2 STRUCTURAL-FRAMING MATERIALS

- A. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; Grade 50 or 55.
- C. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55.

- D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
- F. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55.
- G. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 with G60 coating designation; mill phosphatized. Retain paragraph and subparagraphs below for secondary framing if required.
- H. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
- I. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- J. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
 - 2. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with splined ends.
 - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50, baked epoxy coated.
- K. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- L. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

- M. Threaded Rods: ASTM A 193/A 193M.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Washers: ASTM F 436 hardened carbon steel.
 - 3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- N. Primer: SSPC-Paint 15, Type I, red oxide.

2.3 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS

- A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80, with G90 coating designation.
 - 2. Surface: Smooth, flat finish.
 - 3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings:
 - a. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions, except as modified below:
 - 1) Humidity Resistance: 1000 hours.
 - 2) Salt-Spray Resistance: 1000 hours.
 - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.

2.4 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

- A. Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less.
- B. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method.
 - 1. Composition: White polypropylene film facing and fiberglass-polyester blend fabric backing.

- C. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- E. Refer to Section "Building Insulation" for additional requirements.

2.5 DOOR AND FRAME MATERIALS

- A. Refer to Section "Metal Door and Frames" for exterior door requirement and Section "Overhead Ceiling Doors" for roll up doors.

2.6 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - 1. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Gypsum Board: Refer to Section "Gypsum Board Assemblies" for gypsum board requirements. All gypsum board to be 5/8" thick minimum.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
- E. Metal Panel Sealants:
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray poly-isobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape of manufacturer's standard size.
 - 2. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weather tight; and as recommended by metal building system manufacturer.

3. Refer to Section "Caulking and Sealants" for additional submittal and product requirements.

2.7 FABRICATION, GENERAL

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- C. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.8 STRUCTURAL FRAMING

- A. General:
 1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - a. Make shop connections by welding or by using high-strength bolts.
 - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
 - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - d. Weld clips to frames for attaching secondary framing members.
 - e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
 2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form,

punch, drill, and weld secondary framing for bolted field connections to primary framing.

- a. Make shop connections by welding or by using non-high-strength bolts.
 - b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.
- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by Architect.
 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 3. Frame Configuration: Single gable.
 4. Exterior Column Type: Tapered.
 5. Rafter Type: Tapered.
- C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch.
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
 2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- wide flanges.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch-thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 6. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
 7. Purlin and Girt Clips: Minimum 0.0598-inch-thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch-thick, zinc-coated (galvanized) steel sheet.
 9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch-thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Canopy and Lean to Framing: Manufacturer's standard structural-framing system, designed to withstand required loads, fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: As indicated.
- F. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Cable: ASTM A 475, 1/4-inch-diameter, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- G. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide hot-dipped galvanized bolts for structural-framing components that are galvanized.

- H. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
 - 1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
 - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.9 METAL ROOF PANELS

- A. Trapezoidal-Rib, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels. Exposed metal fasteners for roof panels will not be acceptable.
 - 1. Material: Zinc-coated (galvanized) steel sheet, 0.0269 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range. Color to match existing adjacent metal buildings.
 - 2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel sheet.
 - 3. Joint Type: Mechanically seamed, folded as standard with manufacturer.
 - 4. Panel Coverage: 24 inches.
 - 5. Panel Height: 3 inches.
 - 6. Uplift Rating: UL 90.

2.10 FIELD-ASSEMBLED METAL WALL PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 - 1. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Major-Rib Spacing: 12 inches o.c.
 - 3. Panel Coverage: 36 inches.
 - 4. Panel Height: 1.25 inches.
- B. Tapered-Rib-Profile, Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to

be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch thick.
 - a. Exterior Finish: Acrylic enamel.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: 6 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

2.11 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal roof and wall panels.
 1. Finish: Match finish and color of metal wall panels.
- C. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
 1. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 16 inches.
 3. Panel Height: 1.5 inches.

2.13 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or cross linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1 inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or cross linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D.
- D. Flashing and Trim: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Minimum 0.0269-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

- E. Gutters: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
 - 1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 inches o.c.

- F. Downspouts: Formed from 0.0159-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
 - 1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet o.c.

- G. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
 - 1. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match metal roof panels. Fabricated in minimum 10-foot-long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
 - a. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire, or aluminum, 1/2-inch- square mesh, 0.063-inch wire.
 - b. Dampers: Manually operated, spring-loaded, vertically rising type; chain and worm gear operator; with chain of length required to reach within 36 inches above floor.
 - c. Throat Size: 9 or 12 inches, as standard with manufacturer, and as required to comply with ventilation requirements.

H. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from minimum 0.0428-inch- thick, metallic-coated steel sheet; finished to match metal wall panels. Form blades from 0.0329-inch- thick, metallic-coated steel sheet; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance. Louver sub frames and flashings shall be galvanized and painted with a rust inhibitive coating to match the metal wall panel.

1. Blades: Fixed.
2. Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
3. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire; with rewirable frames, removable and secured with clips, fabricated of same kind and form of metal and with same finish as for louvers.
 - a. Mounting: Interior face of louvers.
4. Vertical Mullions: Provide mullions at spacings recommended by manufacturer, or 72 inches o.c., whichever is less.

I. Roof Curbs: Fabricated from minimum 0.0428-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding indicated loads and of size and height indicated.

1. Curb Sub-framing: Minimum 0.0528-inch- thick, angle-, C-, or Z-shaped steel sheet.
2. Insulation: 1-inch- thick, rigid type.

J. Pipe Flashing: Pre-molded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.14 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.15 SOURCE QUALITY CONTROL

- A. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special Inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.

1. Special inspections will not be required if fabrication is performed by a manufacturer registered and approved by Authorities Having Jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit certificate of compliance with copy to Authorities Having Jurisdiction certifying that Work was performed according to Contract requirements.
- B. Tests and Inspections:
 1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- C. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 1. For the record, prepare written report, endorsed by Erector, listing conditions detrimental to performance of work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors.
 3. Locate canopy framing as indicated.
 4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
 3. Bracing shall be designed by a licensed professional engineer to accommodate wind loading during erection.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal panel manufacturer.

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at peaks rake edges rake walls and each side of ridge caps.
- C. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in predrilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
1. Field-Insulated Assemblies: Install thermal insulation as specified. Install metal liner panels over insulation on interior side of girts at locations indicated. Fasten with exposed fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.8 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
 - 1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 - 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.
 - 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
 - 1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 - 3. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.
 - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- D. Replace torn, cut, or ripped insulation panels, use new undamaged panels.
- E. Install insulation panels to match the metal building exterior at the hangar door.

3.9 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Tie downspouts to underground drainage system indicated.
- E. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.

- F. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
 - 1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
 - 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
 - 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
 - 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Caulking and Sealants" for sealants applied during louver installation.

- G. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.
- B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports.
- C. Tests and Inspections:
 - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

3.11 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
 - 1. Door Closers: Adjust door closers to compensate for final operation of heating and ventilating equipment. Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
 - 2. Refer to Section "Metal Doors and Frames" for additional requirements.

3.12 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

- G. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
 - 1. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 13 34 19

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SECTION 15000 GENERAL WORK REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. The provisions of General Conditions or any other pertinent documents issued including all parts of the plans and specifications for the entire job, whether attached hereto or not, shall be made a part of this section.

1.2 WORK INCLUDED:

- A. Provide all labor, equipment, appliances, and material in strict accordance with the Project Manual and the applicable drawing. Include all appurtenances necessary for the proper operation of the systems and equipment specified.

1.3 DRAWINGS:

- A. The Mechanical Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over Mechanical Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

1.4 CODES AND STANDARDS:

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.
- B. In case of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Architect in writing of any such conflicts.
- C. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.

1) Building Codes:

- a) Fire Prevention Code - Arkansas Fire Prevention Code Vol. 1 & 2
- b) Earthquake Code - International Building Code

- c) Plumbing Code - Arkansas State Plumbing Code
 - d) Gas Code - Arkansas State Gas Code
 - e) Mechanical Code - Arkansas Mechanical Code
 - f) Energy Code - Arkansas Rules & Regulations for Energy Efficiency Standards for New Construction
 - g) Electric Code - National Electric Code
 - h) Applicable Local Jurisdictional Requirements & Codes
 - i) International Building Code
- 2) Industry Standards, Codes and Specifications:
- a) AABC - Associated Air Balance Councils
 - b) ANSI - American National Standards Institute
 - c) AMCA - Air Moving & Conditioning Association
 - d) ARI - American Refrigeration Institute
 - e) ASA - American Standards Association
 - f) ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
 - g) ASME - American Society of Mechanical Engineers
 - h) ASTM - American Society of Testing Materials
 - i) AWWA - American Water Works Association
 - j) AWS - American Welding Society
 - k) MSS - Manufacturer's Standardization Society
 - l) NBS - National Bureau of Standards
 - m) NEBB - National Environmental Balancing Bureau
 - n) NFPA - National Fire Protection Association
 - o) SMACNA - Sheet Metal & Air Conditioning Contractors National Association
 - p) UL - Underwriters' Laboratories, Inc.

1.5 FEES, PERMITS AND INSPECTIONS:

- A. The Contractor shall obtain and pay all required fees, permits and inspections of all kind under the section of the specifications for which they are required.
- B. The Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Architect from the inspection department having jurisdiction for each applicable section of the specifications.

1.6 CHARTS, DIAGRAMS AND SCHEMES:

- A. Charts, diagrams and schemes listed below shall be provided by the Contractor. The number, arrangement and details of construction shall be approved by the Architect.
- B. Lubrication charts shall list all types of lubricant for each piece of equipment, and recommended frequency of lubrication.
- C. Valve tag schedule shall list all isolation and control valves by system. Scheme shall be an extension of the Owner's existing system.
- D. Filter schedules shall list all filters required by each piece of equipment as well as the total requirement for each filter model and size.
- E. Automatic Temperature Control Diagrams, including a detailed sequence of operation, referencing each control device for each function.
- F. Test and Balance Reports per section 15990 of the specifications.

1.7 INSPECTION OF PREMISES:

- A. Before submitting a proposal on this work, the Contractor visit the site of the proposed work and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.8 SUBMITTAL ADMINISTRATIVE REQUIREMENTS:

- A. General Submittal Procedure Requirements:
 - 1) Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - a) Submit submittals to Architect.'
 - b) Architect will return annotated file.
 - 2) Digital Data Files:

- a) Electronic data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
 - b) Cost to the Contractor shall be \$50 for AutoCAD drawings or \$100 for Revit models (if available).
 - c) Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form.
 - d) A signed release form and payment must be returned to the Engineer prior to the transmission of any electronic digital data files.
- 3) Coordination:
- a) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - b) Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - c) Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - d) Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - e) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- 4) Processing Time:
- a) Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - b) Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 - c) Resubmittal Review: Allow 14 days for review of each resubmittal.
- 5) Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

- a) Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
- b) Name file with submittal number or other unique identifier, including revision identifier.
- c) Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
- d) Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
 - i. Project name.
 - ii. Date.
 - iii. Name and address of Engineer.
 - iv. Name of Construction Manager.
 - v. Name of Contractor.
 - vi. Name of firm or entity that prepared submittal.
 - vii. Names of subcontractor, manufacturer, and supplier.
 - viii. Category and type of submittal.
 - ix. Submittal purpose and description.
 - x. Specification Section number and title.
 - xi. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - xii. Drawing number and detail references, as appropriate.
 - xiii. Location(s) where product is to be installed, as appropriate.
 - xiv. Related physical samples submitted directly.
 - xv. Indication of full or partial submittal.
 - xvi. Transmittal number.
 - xvii. Submittal and transmittal distribution record.
 - xviii. Other necessary identification.
 - xix. Remarks.

- 6) Options:
 - a) Identify options requiring selection by Engineer.
- 7) Deviations and Additional Information:
 - a) On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- 8) Resubmittals:
 - a) Make resubmittals in same form and number of copies as initial submittal.
 - b) Note date and content of previous submittal.
 - c) Note date and content of revision in label or title block and clearly indicate extent of revision.
 - d) Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- 9) Distribution:
 - a) Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- 10) Use for Construction:
 - a) Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
- 11) Comparable Product Requests:
 - a) Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - b) Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - c) Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 14

days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- i. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.9 CLOSEOUT SUBMITTALS

- A. Closeout submittals shall include, but not limited to, the following:

- 1) Operation and Maintenance Materials
- 2) Record Drawings
- 3) Demonstration and Training Materials
- 4) Final Approved Submittals

1.10 INSTRUCTIONS OF OWNER'S REPRESENTATIVE:

- A. The Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical and electrical systems. A competent representative of the Contractor shall spend sufficient time in such formal instruction to fully prepare the Owner to operate and maintain the Mechanical Systems.

1.11 GUARANTEE:

- A. The Contractor shall furnish a written certificate, guarantying all materials, equipment, and labor furnished to be free of all defects for a period of one year from the date of final acceptance of the work by the Architect. The Contractor shall further guarantee that if any defects appear within the stipulated guaranty period, such work shall be replaced without charges.

1.12 EXTENDED WARRANTIES:

- A. Some items of specific equipment are specified to be furnished with extended warranties. The extension of time specified for these warranties shall commence or initiate one (1) year after the final acceptance by the Architect.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 5) Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

- 6) Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
- 7) Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- 8) Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

- 1) Store products to allow for inspection and measurement of quantity or counting of units.
- 2) Store materials in a manner that will not endanger Project structure.
- 3) Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.
- 4) Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
- 5) Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 6) Protect stored products from damage and liquids from freezing.
- 7) Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.14 DEFINITIONS:

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, 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 duct shafts.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

- 1) Submit electronic submittals to Engineer.
 - a) Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
- 2) Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - a) If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - b) Mark each copy of each submittal to show which products and options are applicable.
 - c) Include the following information, as applicable:
 - i. Manufacturer's catalog cuts.
 - ii. Manufacturer's product specifications.
 - iii. Standard color charts.
 - iv. Statement of compliance with specified referenced standards.
 - v. Testing by recognized testing agency.
 - vi. Application of testing agency labels and seals.
 - vii. Notation of coordination requirements.
 - viii. Availability and delivery time information.
 - d) For equipment, include the following in addition to the above, as applicable:
 - i. Wiring diagrams showing factory-installed wiring.

- ii. Printed performance curves.
 - iii. Operational range diagrams.
 - iv. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 3) Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
 - 4) Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."
 - 5) Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."
 - 6) Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
 - 7) Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

2.2 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1) Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2) Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3) Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 - 4) Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 5) Where products are accompanied by the term "as selected," Engineer will make selection.
 - 6) Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

- 7) Products containing asbestos shall not be used.
- 8) Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

2.3 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 - B. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - C. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - D. Evidence that proposed product provides specified warranty.
 - E. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - F. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections.

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION:

- A. Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated on the drawings. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
- B. Furnish engraved plastic laminate signs on all panels and equipment:
 - 1) Signs shall be constructed of ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
 - 2) Fabricate in sizes required for message. Provide holes for mechanical fastening. Engraving shall be engraver's standard letter style, of sizes and with terms to match equipment identification. Thickness shall be 1/8 inch for units up to 20 square inches or 8 inches in length.

- 3) Fasteners shall be self-tapping, stainless steel screws or contact-type, permanent adhesive.
- C. Control Items: Label all thermostats.
- D. Valve Tags:
- 1) Provide for all HVAC valves.
 - 2) Furnish and install valve tags with engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.

2.5 EQUIPMENT AND MATERIALS:

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- D. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
- F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.
- G. It shall be the responsibility of the Contractor to ensure that furnished items fit the space available. The Contractor shall make necessary field measurements

to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.

- H. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

2.6 EQUIPMENT ACCESSORIES:

- A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.
- B. Connections: All piping connecting to equipment shall be installed without strain at the piping connection.
- C. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, ductwork, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

2.7 ELECTRIC MOTORS:

- A. Refer to Division 16 for applicable requirements for electric motors.
- B. This Contractor shall furnish electric motors with full load efficiencies not less than the values scheduled on the drawings.

PART 3 - EXECUTION

3.1 COORDINATION OF WORK:

- A. The Contractor shall compare the Mechanical Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the Mechanical Work. The Mechanical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences.

All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

- B. Anchor bolts, sleeves, inserts and supports that may be required for the Mechanical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also ensure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of pipes, ducts, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.
 - 1) Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
 - 2) Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to affect these offsets, transitions and changes in direction.
- E. Installation and Arrangement:
 - 1) The Contractor shall install all Mechanical Work to permit removal (without damage to other parts) of coils, fans, filters, and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
- F. Ductwork:

- 1) The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Architect prior to fabrication of ductwork requiring such changes.

G. Coordination Drawings:

- 1) The Contractor shall furnish detailed coordination drawings for all congested areas including but not limited to Mechanical Rooms, and space restricted ceiling cavities. Coordination drawings shall indicate room dimensions, support column locations, and space requirements for installation and access. Include the following:
 - a) Planned piping layout, including valve and specialty locations and trench locations.
 - b) Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - c) Equipment and accessory locations, service connections, and support details.
 - d) Exterior wall and foundation penetrations and sleeve locations.
 - e) Sizes and location of required concrete pads and bases.
 - f) Floor plans, elevations, and details to indicate penetrations in floors, walls, and roofs and their relationship to other penetrations and installations.
 - g) Layout shall include all other trades impacting the mechanical work such as electrical equipment.

H. Access:

- 1) The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves and dampers. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

I. Drawings by Contractor:

- 1) When directed by the Architect, the Contractor shall submit for approval by the Architect drawings clearly showing the Mechanical Work and its relation

to the work of other trades before commencing shop fabrication or erection in the field.

3.2 AS-BUILT DRAWINGS:

- A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the Drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job. Exact location of all piping and utility service entrances and their connections to utility mains as well as all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Owner one (1) set of "As-Built" reproduces legibly and accurately marked to indicate all changes, additions, deletions, etc., from the Contract Drawings.

3.3 CUTTING AND PATCHING:

- A. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any structural element, beam or column without explicit instructions from the Architect.
- B. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of his fault, error or tardiness or because of any damage done by him.

3.4 EXCAVATION AND TRENCHING FOR PIPING:

- A. The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings, or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other methods. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe or duct can be safely and properly installed and backfill can be properly tamped in such tunnel sections. The Contractor shall be responsible for shoring all trenches in accordance with industry standards and local codes. The Contractor shall be liable for the safety of the workmen in the trench and observe safety rules at all times.
- B. Trench Excavation:
 - a) Trenches shall be of necessity width for the proper laying of the piping, and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point

along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum overdepth of 4" below the trench depths indicated on the drawings or specified. Overdepths in the rock excavation and unauthorized overdepths shall be backfilled with loose, granular, moist earth, thoroughly tamped. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel or other suitable material, as hereinafter specified.

C. Depth of Cover:

- a) Trenches for utilities shall be of a depth that will provide the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

- i. Two (2) feet - six (6) inches minimum cover: Natural gas.

D. Excavations for Appurtenances:

- a) Excavation for manholes and similar structures shall be sufficient to level at least 12" in the clear between their outer surfaces and the embankment or timbers which may be used to hold and protect the banks. Any overdepth excavation below such appurtenances shall be considered as unauthorized and shall be filled with sand, gravel, or concrete at the expense of the Contractor.

E. Protection of Existing Utilities:

- a) Existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

F. No blasting will be allowed.

3.5 BACKFILLING OF TRENCHES:

- A. Trenches shall not be backfilled until all required pressure and other tests have been performed, witnessed by the Architect, and until the utilities systems as installed confirm to the requirements of the drawings and specifications.

B. Normal Backfill:

- a) Where compacted backfill is not specified the trenches shall be carefully backfilled with the materials approved for backfilling (See appropriate section), deposited in 6" layers and thoroughly and carefully rammed until the pipe has a cover of not less than one foot. The remainder of the backfill material shall then be carefully placed in the trench in one (1) foot layers and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition.
- C. Compacted backfill shall be used under slabs on grade, building structure, concrete paving and asphaltic concrete paving. The soils used in the fill shall be granular in nature and shall not contain roots, sod, rubbish or stones over 1-1/2" maximum dimension.
 - a) Required Density:
 - i. All fills shall be compacted to a dry density equal to at least 90 % of the maximum density determined in accordance with the Modified AASHO Method of Compaction. The maximum density and optimum moisture content shall be determined on the basis of laboratory tests conducted on the materials used in the fill.
 - ii. Modified AASHO Compaction Method provides that soil samples be compacted in five (5) equal layers in a standard compaction cylinder having a volume of 1/30 cu. ft. using twenty-five (25) 18" blows of 10 pound rammer to compact each layer.
 - b) Control Tests:
 - i. Adequacy of compaction shall be determined on the basis of in-place density determinations that are to be conducted while the fills are being placed. The results of these tests shall be the basis on which satisfactory completion of the work is judged. Should the fills fail to meet the specified densities, the Contractor shall remove and recompact the soils until the specified densities are achieved.
 - c) Equipment:
 - i. The choice of compaction equipment shall be made by the Contractor; however, the equipment shall be adequate for achieving the specified densities. Use of hand-operated, power-driven compaction equipment may be necessary at locations inaccessible to roller-type equipment.

3.6 CONSTRUCTION PHASING:

- A. The Contractor shall refer to the General Requirements of this specification and prepare all work schedules required to perform all work as shown on the Drawings and as herein specified.

3.7 INTERRUPTION OF SERVICES:

- A. The progress of the job will require interruption of certain services in order to make connections and change over to new systems, including routing piping, ductwork, etc. through occupied areas. In general, this type of work shall be done late at night (after 10:00 p.m.), weekends (day or night) or early in the morning (before 6:00 a.m.) or as described in the phasing plan or schedule. The Contractor shall visit the job site to determine extent of interruptions required by herein specified work. Requests for interruptions shall be made one week prior to planned shutdown, and must be coordinated with the Architect, Engineer, and Owners' Representative. No interruption will be allowed without written approval from the Owner. The cost of interruptions shall be a part of the Contract Amount. No additional cost to the Owner will be allowed for interruptions, no matter how many are required.
- B. Any accidental disturbance of service as a result of this Contract will be immediately restored at no additional cost to the Owner.
- C. If service changes require temporary connections, the Contractor will make all necessary arrangements for such temporary connections and furnish the required materials and labor at no additional cost to the Owner.

3.8 PAINTING:

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - a) Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - b) Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over galvanized metal primer.
 - c) Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - d) Exterior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over rust-inhibitive metal primer.
 - e) Exterior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over galvanized metal primer.

- f) Exterior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over rust-inhibitive metal primer.

- C. Do not paint piping specialties with factory-applied finish.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- E. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

3.9 LUBRICATION:

- A. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Fan shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

3.10 ELECTRICAL WORK:

- A. All power and motor wiring shall be done by the Electrical Contractor unless otherwise noted for specific items. Control and interlock wiring shall be done by the Mechanical Contractor.
- B. The Mechanical Contractor shall furnish and install any low voltage relays, pressure switches, thermostats and similar items required for the proper operation of the mechanical equipment.
- C. The Electrical Contractor shall furnish all motor starters and drives unless included in other sections of the specifications. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.

3.11 ELECTRIC MOTORS:

- A. Refer to Division 16 for applicable requirements for electric motors.
- B. Furnish and install electric motors with energy efficiencies not less than the values scheduled on the drawings.

3.12 SWITCHGEAR DRIP PROTECTION:

- A. Every effort shall be made to eliminate the installation of pipe above electrical, telephone and data equipment. If this is not possible, the Contractor shall notify the Architect before proceeding with installation. Upon approval by the Architect, the Contractor shall encase the pipe in a second pipe with a minimum number of

joints. Provide 18 gauge (minimum) galvanized, four inch (minimum) deep drain pans under existing piping located or passing over electrical switchgear or distribution panels. Pipe 1" drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold four inches of water without collapse.

3.13 EQUIPMENT START-UP AND TESTING:

- A. The Contractor shall instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment, including pumps and boilers. During the operating tests, the Contractor shall provide the operation of each item of equipment. At least seven (7) days' notice shall be given to the Architect of equipment start-up and operating tests.

3.14 INACCESSIBLE EQUIPMENT:

- A. Where the Architect or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
- B. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.15 DEMOLITION:

- A. Disconnect, demolish, and remove Work specified in Division 15 Sections.
- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of two (2) inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.

- 3.16 SALVAGE: The Owner shall have the first right of refusal of all equipment and materials being removed. The Contractor shall coordinate with the Owner, before demolition begins, to determine which equipment and materials will be retained by the Owner. The Contractor shall remove and transport said equipment and materials to storage facilities on site, as directed by the Owner. All other material being removed shall be disposed of in a legal landfill by the Contractor. The Contractor shall be responsible for all costs incurred in transporting and disposing of salvage materials.

END OF SECTION 15000

SECTION 15060 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The provisions of General Conditions or any other pertinent documents issued including all parts of the plans and specifications for the entire job, whether attached hereto or not, shall be made a part of this section.

1.2 DESCRIPTION

- A. Provide pipe, pipe fittings and related items required for complete piping system.

1.3 RELATED WORK:

- A. Section 15000 - Basic Mechanical Requirements
- B. Section 15090 - Mechanical Supporting Systems
- C. Section 15120 - Valves
- D. Section 15190 - Mechanical Identification
- E. Section 15401 - Domestic Water System
- F. Section 15405 - Drainage, Sanitary Waste & Vent System

1.4 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacturer of pipe, tube, and fittings of types and sizes required, whose products have been in satisfactory use in similar service.
- B. Welding: Qualify welding procedures, welders and operators in accordance with ANSI B31.1, paragraph 127.5, for shop and project site welding of piping work.
- C. Brazing: Certify brazing procedures, brazers, and operators in accordance with ANSI B31.5, paragraph 527.5 for shop and job-site brazing of piping work.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Provide factory-applied plastic and end-caps on each length of pipe and tube intended for clean use. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.6 SEQUENCING AND SCHEDULING:

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical 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 connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- D. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 NOISE CONTROL:

- A. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise. Where excessive noise is generated in a piping system, due to arrangement or velocity of the fluid within the pipe, the contractor shall make modifications as required or as directed by the Engineer, to reduce noise to an acceptable level.

1.8 CROSS-CONNECTIONS:

- A. No piping shall be installed which will provide a cross-connection between potable water system and a polluted supply.

1.9 PIPE IDENTIFICATION:

- A. A stenciled legend identifying the gas or fluid conveyed and direction of flow shall be indicated on all piping by the trade furnishing and installing the pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts,

tunnels, and plenums; and exterior non-concealed locations according to the following:

1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 3. Near penetrations through walls, floors, ceilings, or non-accessible 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 a maximum of 20-foot intervals along each run.
 7. On piping above removable acoustical ceilings.
- C. Identification and symbols shall comply with latest edition of ANSI A.13.1. Letters shall be sized in accordance with the following:

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	HEIGHT OF LEGEND LETTERS
Up to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/2"
Over 6"	24"	2-1/2"

PART 2 - PRODUCTS

2.01 PIPING MATERIALS:

- A. Steel Pipe:
1. Black steel ANSI / ASTM A 53, Grade "B", seamless or ERW (2" and larger).
 2. Black steel ANSI / ASTM A 53, Grade "F", continuous weld (1/2" up to 2").

3. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedules 40 and 80, carbon steel, seamless for 2-inch NPS and smaller and electric-resistance welded for 2-1/2-inch NPS and larger.

B. Copper Tube:

1. Copper Tube: ANSI / ASTM B 88; Type as indicated for each service; hard drawn above grade and soft drawn below grade.
2. DWV Copper Tube: ANSI / ASTM B 306.

C. Polyvinyl Chloride Pipe:

1. Gravity Sewer Pipe: Hub And Spigot; ASTM D-2665 drain waste and vent Schedule 40 PVC.
2. Pressure Pipe:
 - a. AWWA C900, Class 150; ASTM D-1509, ASTM D-1869. ASTM D - 2241 and ASTM D-2444.
 - b. Schedule 40 PVC / CPVC or Schedule 80 PVC / CPVC; ASTM D-1784, ASTM D-1785 and ASTM F - 441.

2.02 FITTING MATERIALS:

A. Fittings for Steel Pipe:

1. Malleable Iron Threaded Fittings: ANSI B16.3
2. Malleable Iron Threaded Unions: ANSI B16.39
3. Malleable Iron Threaded Flanges: ANSI B16.3, ASTM A197
4. Butt-Weld Steel Fittings: ANSI B16.9, ASTM A 234. All ells shall be long radius.
5. Pipe Flanges and Flanged Fittings: ANSI B16.5
6. Socket Welded or Threaded Fittings: ANSI B16.11
7. Stainless Steel Butt-Weld Steel Fittings: ANSI B16.9 Subclass WP-W, ASTM A 403

B. Fittings for Copper Pipe:

1. Cast Brass Solder Joint Fittings: ANSI B16.18
2. Cast Copper Alloy Solder Joint Drainage Fittings: ANSI B16.23

3. Cast Brass Flared Tube Fittings: ANSI B16.26
4. Wrought Copper Solder Joint Fittings: ANSI B16.22
5. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29
6. Non-Ferrous Pipe Flanges: ANSI B16.31
7. Flared Copper Fittings: SAE J513 and ANSI B70.1

C. Fittings for Cast Iron Pipe:

1. Hubless Cast-Iron Soil Pipe Fittings: CISPI 301
2. Cast Iron Hub and Spigot Soil Pipe Fittings: ASTM A-74 and ANSI A-112.5-1
3. Double Seal Compression Type Gaskets: ASTM C-564

D. Fittings For Polyvinyl Chloride Pipe:

1. Gravity Sewer Pipe: Hub and Spigot; ASTM D-3034 Schedule 40 drain, waste and vent. Joints: ASTM D-3212.
2. Pressure Pipe Fittings:
 - a. Gray iron Class 150 ANSI / AWWA C110 / A.21.1; Cement-Mortar Lining for Ductile Iron Pipe and Fittings: ANSI / AWWA C104 / A.21.4. Minimum thickness shall be Class 50, unless otherwise noted. Mechanical joints: ANSI / AWWA C111 / A 21.11.
 - b. Schedule 40 PVC / CPVC pressure rated socket type, ASTM D-2466 or F-438.
 - c. Schedule 80 PVC / CPVC pressure rated type, ASTM D-2467 or F-439.

2.03 PIPE AND FITTINGS:

- A. Condensate, Equipment, and Relief Drains: One and one-fourth (1-1/4) inch or larger drains shall be DWV copper. One (1) inch and smaller drains shall be Type "M" copper. Fittings shall be cast brass drainage fittings or wrought copper (one (1) inch and smaller). Joints shall be made with Stay Safe "Bridgit" Lead Free Solder, or equal.
- B. Domestic Hot and Cold Water Piping:
 1. All other cold and hot water piping within the building unless noted otherwise shall be Type "L" hard drawn copper tubing, with solder joint wrought copper tube fittings. Joints shall be made with Stay

Safe "Bridgit" Lead Free Solder, or equal. Lead solder shall NOT be used on any system.

2. Adaptors shall be used for screwed valves in copper piping. Connections between copper and steel shall be insulated to prevent electrolysis. All water piping shall pitch to low point to drain.

C. Water and Sewer Mains:

1. Exterior fire protection service line shall be ductile iron with push-on joints. Fittings shall be cast iron with mechanical joint.
2. Hot and cold water piping, including water service, which is run in or under the building, shall be Type "K" hard drawn copper tubing. Joints shall be made with 15 % silver solder. Cold water piping 4" and larger, including water service, which is run underground (outside the building footprint), may be ductile iron piping.
3. Exterior sewer main shall be cast iron single hub pipe with hub and spigot fittings up to initial manhole connection. Refer to site plan for continuation. Hub gaskets shall be equal to Tyler Pipe "Ty-seal".
4. Exterior storm drain shall be Schedule 35 PVC with push on joints.

D. Fire Protection Piping: Refer to Section 15500.

E. Sanitary Sewer, Storm Sewer, and Vent Piping:

1. Waste arms for lavatories and sinks shall be DWV copper with cast brass adaptors and wrought copper fittings. All interior sanitary sewer, vent, and storm drain piping above grade shall be standard weight cast iron soil pipe and with no-hub fittings, unless noted otherwise. Sanitary sewer, vent and storm drain piping below grade shall be standard weight cast iron soil pipe with hub and spigot fittings. Hub gaskets shall be equal to Tyler Pipe's "Ty-seal".
2. Piping must be of sizes noted and run as indicated on the drawings, and shall be given a uniform grade of 1/4" per foot wherever possible, but in no case less than 1/8" per foot, unless otherwise noted on plans. The soil and waste vent piping shall be extended through roof. Each riser extending through roof shall project 10" above roof lines and shall be thoroughly flashed as detailed on drawings.

F. Couplings and Nipples:

1. Couplings shall have an iron-body sleeve assembly, fabricated to match outside diameter of plain-end, pressure pipes, with an ASTM A 126, Class B, gray iron sleeve. Followers shall be constructed of ASTM A 47 malleable iron or ASTM A 536 ductile iron. Gaskets

shall be constructed of rubber and bolts and nuts shall comply with AWWA C111.

2. Dielectric couplings shall be galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
3. Dielectric nipples shall be electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

G. Unions:

1. All union connections in copper piping shall be ground joint brass unions, having brass taper seat and both screw ends hexagonal and shall be designed for a steam working pressure up to 125 pounds.
2. Union connections in steel piping shall be heavy pattern ground joint malleable unions of same finish as pipe, having brass taper seat and hexagonal screw ends and shall meet same pressure ratings as fittings for that particular piping system. Union connections of similar piping 2-1/2" and larger shall be made with malleable iron gasketed type flanged unions, meeting same pressure ratings as fittings for that particular piping system.
3. Dielectric unions complying with ANSI B16.39 or insulating flange gasket and bolt sleeves complying with ANSI B16.42 shall be installed where jointing occurs of two (2) dissimilar metal pipes.

H. Pipe Joints:

1. Threaded Joints:
 - a. 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 inner diameter. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - b. Join pipe fittings and valves as follows:
 1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 3. Align threads at point of assembly.

4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 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.
2. Brazed Joints:
 - a. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube".
 3. Soldered Joints:
 - a. Joints in copper pipe shall be sanded and lead free solder used on fittings and joints. Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook".
 4. Welded Joints:
 - a. Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 5. Flanged Joints:
 - a. Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
 - b. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 6. Plastic Piping Solvent-Cement Joints
 - a. Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
- I. Pipe Flanges:
 1. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full face neoprene gasket suitable for 220 degrees F complying with ASME B16.21. At the Contractor's option, convoluted, cold formed

150 pound steel flanges, with teflon gaskets, may be used for water service.

2. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
 3. Where ferrous flanges are connected to non-ferrous flanges, install dielectric insulating flange gasket and bolt sleeve kits. Components shall include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- J. Mechanical Pipe Couplings and Fittings may be used where specifically noted with cut or roll grooved pipe, in water service up to 230 degrees F in lieu of welded, screwed or flanged connections.
1. Grooved Mechanical Couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two (2) or more parts, securely held together by two (2) or more track-head, square, or oval-neck bolts, ASTM A183.
 2. Gaskets: Synthetic rubber product recommended by the coupling manufacturer for the intended service.
 3. Grooved End Fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Piping shall be properly supported and adequate provisions shall be made for expansion, contraction, slope, and anchors. High points of all water piping and where flow in pipe turns down shall be vented by means of extending vent pipe, with terminal 1/4" globe valve to an accessible position 6 ft. above floor in mechanical rooms.
- B. All piping shall be cut accurately for fabrication to measurements established at the construction site.
- C. Pipe shall be worked into place without springs and / or forcing, properly clearing all windows, doors and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will NOT be permitted.
- D. All pipes shall have burr and cutting slag removed by reaming or other cleaning methods.
- E. All changes in direction shall be made with fittings; bending of pipe will not be permitted.

- F. Trench Indicators: Furnish in all exterior pipe trenches, color coded vinyl detector tape with metallic facing.
- G. Copper pipe routed below grade under concrete or fill which may attack the pipe surface shall be sleeved with a 4 mil thickness polyethylene sleeve, equal to Oatey's Pipe Guard". Hot water lines shall have a red sleeved and cold water shall be installed in a blue sleeve.

3.02 ARRANGEMENT:

- A. All piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes, or other access openings.
- B. Unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment valves on special fittings. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc.
- C. Flanges, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment valves on special fittings. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc.
- D. When horizontal lines are reduced in size (in the direction of flow), eccentric reducing fittings shall be used. Eccentric fittings shall be installed with the "flat" on top for fluids and the "flat" on bottom for vapors; steam, compressed air, refrigerant, etc. When horizontal lines are increased in size (in the direction of flow), concentric reducing fittings shall be used. No bushings will be permitted.

3.03 TESTING:

- A. Test all piping systems provided under this contract and obtain approval from the Architect before acceptance. Testing shall be done before piping is concealed or connected to equipment or outlets.
- B. The Contractor shall record the ambient temperature and the gas or fluid temperature within the piping prior to testing. The Contractor shall not test piping at pressures exceeding the manufacturer's published ratings for the job site conditions. In the event of a contradiction between the manufacturer's testing recommendations and the instructions listed below, the Contractor shall notify the Engineer in writing of such discrepancy and suspend testing until receiving further instruction from the Engineer.
- C. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
- D. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing

against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.

- E. Install relief valve set at a pressure no more than one-third (1/3) higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- F. Testing Requirements:
 - 1. Sanitary Sewer: Test with water to a head of 10 ft. for 1 hour.
 - 2. Domestic Water: Test with nitrogen at 100 psig for 24 hours.
 - 3. HVAC Piping: Test with nitrogen at 100 psig for 24 hours.

END OF SECTION 15060

SECTION 15061 FACILITY NATURAL GAS PIPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.2 RELATED REQUIREMENTS

A. Section 08 3100 - access doors and panels.

- 1) Section 09 9113 - exterior painting.
- 2) Section 09 9123 - interior painting.
- 3) Section 22 0516 - expansion fittings and loops for plumbing piping.
- 4) Section 22 0548 - vibration and seismic controls for plumbing piping and equipment.
- 5) Section 22 0719 - plumbing piping insulation.
- 6) Section 31 2316 - excavation.
- 7) Section 31 2323 - fill.
- 8) Section 33 5216 - gas hydrocarbon piping.

1.3 REFERENCE STANDARDS

- 1) Ansi z21.18/csa 6.3 - gas appliance pressure regulators 2019.
- 2) Ansi z21.80/csa 6.22 - line pressure regulators 2011 (addendum a, 2012).
- 3) Ansi z223.1 - national fuel gas code 2016.
- 4) Asme bpvc-ix - qualification standard for welding, brazing, and fusing procedures; welders; brazers; and welding, brazing, and fusing operators - welding brazing and fusing qualifications 2019.
- 5) Asme b16.3 - malleable iron threaded fittings: classes 150 and 300 2016.
- 6) Asme b31.1 - power piping 2018.
- 7) Astm a53/a53m - standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless 2018.
- 8) Astm a234/a234m - standard specification for piping fittings of wrought carbon steel and alloy steel for moderate and high temperature service 2019.
- 9) Astm b813 - standard specification for liquid and paste fluxes for soldering of copper and copper alloy tube 2016.
- 10) Astm b828 - standard practice for making capillary joints by soldering of copper and copper alloy tube and fittings 2016.
- 11) Awwa c105/a21.5 - polyethylene encasement for ductile-iron pipe systems 2010.
- 12) lcc-es ac193 - acceptance criteria for mechanical anchors in concrete elements 2015.
- 13) lcc-es ac308 - acceptance criteria for post-installed adhesive anchors in concrete elements 2016.

14) Mss sp-78 - cast iron plug valves, flanged and threaded ends 2011.

15) Mss sp-110 - ball valves threaded, socket-welding, solder joint, grooved and flared ends 2010.

1.4 SUBMITTALS

- A. SEE SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS, FOR SUBMITTAL PROCEDURES.
- B. Product data: provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welder certificate: include welders certification of compliance with asme bpvc-ix.
- D. Project record documents: record actual locations of valves.
- E. Maintenance materials: furnish the following for owner's use in maintenance of project.
- F. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 – PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
 - 1) Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2) Joints: ANSI Z223.1, welded.

- 3) Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. NATURAL GAS PIPING, ABOVE GRADE

C. Steel Pipe: ASTM A53/A53M, Schedule 40 black.

- 1) Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
- 2) Joints: Threaded or welded to ASME B31.1.

2.2 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

- 1) Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 1 Inch:

- 1) Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

- 1) If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- 2) Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
- 3) Trapeze Hangers: Welded steel channel frames attached to structure.
- 4) Vertical Pipe Support: Steel riser clamp.
- 5) Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

- 1) Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
- 2) Concrete Screw Type Anchors: Complying with ICC-ES AC193.
- 3) Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.4 BALL VALVES

A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.5 PLUG VALVES

A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.6 STRAINERS

- A. Size 2 inch and Under:
 - 1) Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - 2) Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - B. Size 1-1/2 inch to 4 inch:
 - 1) Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- 2.7 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS
- A. Compliance Requirements:
 - 1) Appliance Regulator: ANSI Z21.18/CSA 6.3.
 - 2) Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
 - B. Materials in Contact With Gas:
 - 1) Housing: Aluminum, steel (free of non-ferrous metals).
 - 2) Seals and Diaphragms: NBR-based rubber.
 - C. Maximum Inlet Operating Pressure: 10 psi.
 - 1) Appliance Regulator: 10 psi.
 - 2) Line Pressure Regulator: 10 psi.
 - D. Maximum Body Pressure: 10 psi.
 - E. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - 1) Refer to Section 22 0719.
- H. Provide access where valves and fittings are not exposed.
 - 1) Coordinate size and location of access doors with Section 08 3100.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
 - 1) Painting of interior piping systems and components is specified in Section 09 9123.
 - 2) Painting of exterior piping systems and components is specified in Section 09 9113.
- L. Excavate in accordance with Section 31 2316.
- M. Backfill in accordance with Section 31 2323.
- N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- P. Sleeve pipes passing through partitions, walls and floors.
- Q. Inserts:
 - 1) Provide inserts for placement in concrete formwork.
- R. Pipe Hangers and Supports:
 - 1) Support horizontal piping as indicated.
 - 2) Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3) Place hangers within 12 inches of each horizontal elbow.
 - 4) Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5) Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 6) Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

- a) Painting of interior piping systems and components is specified in Section 09 9123.
 - b) Painting of exterior piping systems and components is specified in Section 09 9113.
- 7) Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.
- E. Provide plug valves in natural gas systems for shut-off service.

3.5 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators in accordance with Section 33 5216. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.6 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1) Metal Piping:
 - a) Pipe Size: 1/2 inches to 1-1/4 inches:
 - i. Maximum Hanger Spacing: 6.5 ft.
 - ii. Hanger Rod Diameter: 3/8 inches.
 - b) Pipe Size: 1-1/2 inches to 2 inches:
 - i. Maximum Hanger Spacing: 10 ft.
 - ii. Hanger Rod Diameter: 3/8 inch.

END OF SECTION 15061

SECTION 15062 REFRIGERANT PIPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.
- N. Engineered wall seals and insulation protection.
- O. Exterior penetration accessories.

1.2 RELATED REQUIREMENTS

- A. Section 23 0719 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers 2005.
- B. AHRI 710 - Performance Rating of Liquid-Line Driers 2009.
- C. AHRI 750 - Thermostatic Refrigerant Expansion Valves 2007.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants 2019.
- E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants 2019.
- F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2019.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

- K. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.
- L. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011 (Amended 2012).
- M. ICC (IMC)-2018 - International Mechanical Code 2018.
- N. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 – PRODUCTS

2.1 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
- B. Fittings: ASME B16.22 wrought copper.
- C. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- D. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
- E. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
- F. Fittings: ASME B16.26 cast copper.
- G. Joints: Flared.

2.2 REFRIGERANT

- A. Refrigerant: R410-A as defined in ASHRAE Std 34.

2.3 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.4 VALVES

- A. Diaphragm Packless Valves:
 - 1) UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 - 1) Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Ball Valves:

- 1) Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:

- 1) Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.5 STRAINERS

A. Straight Line or Angle Line Type:

- 1) Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.6 CHECK VALVES

A. Globe Type:

- 1) Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

B. Straight Through Type:

- 1) Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.7 PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.8 PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.9 FILTER-DRIERS

A. Performance:

- 1) Flow Capacity - Liquid Line: minimum, rated in accordance with AHRI 710.
- 2) Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
- 3) Design Working Pressure: 350 psi, minimum.

- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.

- 1) Connections: As specified for applicable pipe type.

2.10 EXPANSION VALVES

- A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.11 RECEIVERS

- A. Internal Diameter Over 6 inch:
 - 1) AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.12 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

END OF SECTION 15062

SECTION 15073 – SEISMIC / VIBRATION ISOLATION FOR MECHANICAL
COMPONENTS

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Intent:

1. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
5. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements
6. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
7. Seismic restraints shall be designed in accordance with seismic force levels as detailed in section 1.06.

B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Equipment isolation bases.
3. Flexible piping connections.
4. Seismic restraints for isolated equipment.

5. Seismic restraints for non-isolated equipment.
6. Certification of seismic restraint designs and installation supervision.
7. Certification of seismic attachment of housekeeping pads.
8. All mechanical and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).
 - a. Air Handling Units
 - b. Condensing Units
 - c. Cooling Towers
 - d. Ductwork
 - e. Fans (all types)
 - f. Piping
 - g. Unit Heaters
 - h. Water Heaters

C. Definitions

1. Life Safety Systems:
 - a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
 - b. All systems involved with and / or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.
 - c. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
2. Positive Attachment:
 - a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to

structure. Single sided SCB type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic attachment points.

3. Transverse Bracing:
 - a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.
4. Longitudinal Bracing:
 - a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.02 SUBMITTAL DATA REQUIREMENTS:

- A. The manufacturer of vibration isolation and seismic 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 seismic 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 suspended equipment.
 - c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
 - d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

- e. Piping and duct restraint locations shall be field documented during construction. Shop drawings of floor plan layouts shall be prepared indicating actual field conditions and restraint locations shall be clearly identified. Calculations, by a registered professional engineer, and restraint details shall be submitted to the project engineer for approval.

3. Seismic Certification and Analysis:

- a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
- b. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45 to the weakest mode.
- c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.03 CODE AND STANDARDS REQUIREMENTS:

A. Typical Applicable Codes and Standards:

- 1. The Arkansas Fire Prevention Code 2012, based on the International Building Code 2012.
- 2. Sheet Metal and Air Conditioning Contractors National Association's "Seismic Restraint Manual Guidelines for Mechanical Systems – Second Edition".
- 3. National Uniform Seismic Installation Guidelines.

4. NFPA 5000 – The Building Construction and Safety Code.

1.04 MANUFACTURER'S RESPONSIBILITY:

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
1. Determine vibration isolation and seismic restraint sizes and locations.
 2. Provide vibration isolation and seismic restraints as scheduled or specified.
 3. Provide calculations and materials if required for restraint of unisolated equipment.
 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.05 RELATED WORK:

- A. Housekeeping Pads:
1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
 2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
- B. Supplementary Support Steel:
1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof-mounted equipment, as required or specified.
- C. Attachments:
1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.06 SEISMIC FORCE LEVELS:

- A. The following are used to determine the “G” force levels used on this project based on the codes listed in Section 1.03.
1. Component amplification factor (a_p) for each type of component are as follows:
 - a. High Deformability Pipe = 1.0
 - b. Rigidly Mounted Equipment and Limited Deformability Pipe = 1.0
 - c. Vibration Isolated Equipment and Pipe, Pressure Vessels = 2.5
 - d. Low Deformability Pipe = 1.0
 2. Component Response Modification Factor (R_p) for each component are as follows:
 - a. High Deformability Pipe = 3.5
 - b. Rigidly Mounted Equipment and Limited Deformability Pipe = 2.5
 - c. Vibration Isolated Equipment and Pipe, Pressure Vessels = 2.5
 - d. Low Deformability Pipe = 1.25
- B. The following “G” force levels will be used on this project based on the codes listed in Section 1.03.
1. Spectral Response Acceleration at Short Periods (S_s) less than 0.15 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels

- a. Horizontal = 0.10
- b. Vertical = 0.05
- 4. Low Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.15
 - b. Vertical = 0.05
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.12
 - b. Vertical = 0.05
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08

- b. Vertical = 0.05
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.20
 - b. Vertical = 0.05
- 4. Low Deformability Pipe
 - a. Horizontal = 0.16
 - b. Vertical = 0.05
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.10
 - b. Vertical = 0.05
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.25
 - b. Vertical = 0.05
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.16
 - b. Vertical = 0.05
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.09
 - b. Vertical = 0.05

2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.12
 - b. Vertical = 0.05
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.30
 - b. Vertical = 0.05
 4. Low Deformability Pipe
 - a. Horizontal = 0.24
 - b. Vertical = 0.05
2. Spectral Response Acceleration at Short Periods (S_s) between 0.15 and 0.25 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
- a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.17
 - b. Vertical = 0.08
 4. Low Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08

- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.25
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.08
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.34
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe

- a. Horizontal = 0.27
- b. Vertical = 0.08
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.42
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.34
 - b. Vertical = 0.08
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.14
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.50

- b. Vertical = 0.08
- 4. Low Deformability Pipe
 - a. Horizontal = 0.40
 - b. Vertical = 0.08
- 3. Spectral Response Acceleration at Short Periods (S_s) between 0.26 and 0.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.23
 - b. Vertical = 0.11
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.18
 - b. Vertical = 0.11
 - b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe

- a. Horizontal = 0.17
- b. Vertical = 0.11
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.34
 - b. Vertical = 0.11
- 4. Low Deformability Pipe
 - a. Horizontal = 0.27
 - b. Vertical = 0.11
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.18
 - b. Vertical = 0.11
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.46
 - b. Vertical = 0.11
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.36
 - b. Vertical = 0.11
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11

2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.11
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.57
 - b. Vertical = 0.11
 4. Low Deformability Pipe
 - a. Horizontal = 0.46
 - b. Vertical = 0.11
- e. Above 3/4 of the Building Height up to the Roof
1. High Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.11
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.27
 - b. Vertical = 0.11
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.68
 - b. Vertical = 0.11
 4. Low Deformability Pipe
 - a. Horizontal = 0.54
 - b. Vertical = 0.11
4. Spectral Response Acceleration at Short Periods (Ss) between 0.51 and 1.00 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.

- a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.29
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.15
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.44
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe

- a. Horizontal = 0.35
- b. Vertical = 0.15
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.58
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.47
 - b. Vertical = 0.15
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.29
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.73

- b. Vertical = 0.15
- 4. Low Deformability Pipe
 - a. Horizontal = 0.58
 - b. Vertical = 0.15
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.25
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.35
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.88
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.70
 - b. Vertical = 0.15
- 5. Spectral Response Acceleration at Short Periods (Ss) between 1.01 and 1.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe

- a. Horizontal = 0.30
- b. Vertical = 0.20
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.40
 - b. Vertical = 0.20
- 4. Low Deformability Pipe
 - a. Horizontal = 0.32
 - b. Vertical = 0.20
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.60
 - b. Vertical = 0.20
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.48
 - b. Vertical = 0.20
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30

- b. Vertical = 0.20
- 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.32
 - b. Vertical = 0.20
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.80
 - b. Vertical = 0.20
- 4. Low Deformability Pipe
 - a. Horizontal = 0.64
 - b. Vertical = 0.20
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.40
 - b. Vertical = 0.20
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.00
 - b. Vertical = 0.20
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.80
 - b. Vertical = 0.20
- e. Above 3/4 of the Building Height up to the Roof

1. High Deformability Pipe
 - a. Horizontal = 0.34
 - b. Vertical = 0.20
2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.48
 - b. Vertical = 0.20
3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.20
 - b. Vertical = 0.20
4. Low Deformability Pipe
 - a. Horizontal = 0.96
 - b. Vertical = 0.20
6. Spectral Response Acceleration at Short Periods (S_s) greater than 1.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.67
 - b. Vertical = 0.33

4. Low Deformability Pipe
 - a. Horizontal = 0.53
 - b. Vertical = 0.33
- b. Above Ground Level up to 1/4 of the Height of the Building
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.00
 - b. Vertical = 0.33
 4. Low Deformability Pipe
 - a. Horizontal = 0.80
 - b. Vertical = 0.33
- c. Above 1/4 up to 1/2 of the Height of the Building
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.53
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels

- a. Horizontal = 1.34
- b. Vertical = 0.33
- 4. Low Deformability Pipe
 - a. Horizontal = 1.07
 - b. Vertical = 0.33
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.67
 - b. Vertical = 0.33
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.67
 - b. Vertical = 0.33
 - 4. Low Deformability Pipe
 - a. Horizontal = 1.34
 - b. Vertical = 0.33
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 57
 - b. Vertical = 0.33
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.80

- b. Vertical = 0.33
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 2.00
 - b. Vertical = 0.33
- 4. Low Deformability Pipe
 - a. Horizontal = 1.60
 - b. Vertical = 0.33

1.07 QUALITY ASSURANCE:

- A. All vibration isolation and noise control devices shall be designed to meet the requirements of the latest edition of ASHRAE Handbooks.
- B. Noise Criteria:
 - 1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room.
 - 2. For equipment which has no sound power ratings scheduled on the plans, the Contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with the latest edition of ASHRAE Systems Handbook, Sound and Vibration Control chapter. An average value of 5 db shall be used as the room attenuating effect, i.e., the difference between sound power level emitted to room and sound pressure level in room.
 - 3. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
- C. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and / or horizontal permanent deformation greater than 1/4".

PART 2 - PRODUCTS

2.01 PRODUCT DESCRIPTIONS:

- A. Vibration Isolators and Seismic Restraints:
 - 1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load

distribution plates shall be used as required. Pads shall be type Super "W" as manufactured by Mason Industries, Inc.

2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type BR as manufactured by Mason Industries, Inc.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge-bearing quality. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.
4. A one piece molded bridge bearing neoprene washer / bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 % of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the

housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "R" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SLR or SLRS as manufactured by Mason Industries, Inc.

7. Spring mountings as in specification 5 built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SSLFH as manufactured by Mason Industries, Inc.
8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests. Air Springs shall be type MT and leveling valves type LV as manufactured by Mason Industries, Inc.
9. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be type SLR-MT as manufactured by Mason Industries, Inc.
10. Hangers shall consist of rigid steel frames containing minimum 1-1/4" thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis

hangers nor the neoprene element stacked on top of the spring. 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. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.

11. Hangers shall be as described in 10, but they shall be supplied with a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, and equipment. Rubber thickness shall be a minimum of 1/4". Submittals shall include a drawing of the hanger showing the installation of the rebound washer. Hangers shall be type RW30N as manufactured by Mason Industries, Inc.
12. Hangers shall be as described in 10, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
13. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be prestretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
14. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc.

a. Note: Specifications 12-14 apply to trapeze as well as clevis

hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

15. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
16. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
17. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" thick. Rated loadings 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. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be type Z-1225 as manufactured by Mason Industries, Inc.
18. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more than 1/4". Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be type Z-1011 as manufactured by Mason Industries, Inc.

19. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.
20. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.O. Evaluation Service, Inc. verifying to its allowable loads. Drill-in female wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.
21. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type WF as manufactured by Mason Industries, Inc.
22. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.
23. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal or structural steel sections containing adjustable and removable steel springs that support the upper floating section. The upper frame must

provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of 1/4" thick. Steel springs shall be laterally stable and rest on 1/4" thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous flexible flashing nailed over the lower curbs waterproofing. All spring locations shall have accessibility to adjust springs. Lower curbs shall have provision for 2" of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower section anchored to the roof structure. Curb shall have anchorage pre-approval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings. Curb shall be type SRSC or RMSS as manufactured by Mason Industries, Inc.

24. Curb mounted rooftop equipment shall be mounted on top of Rigid Seismic Roof curbs. Curb sections shall be designed by an engineer licensed in the state where the project is, and shall be either structural steel channels or 12-gauge sheet metal. Field assembled joints are to include a minimum of 2 rows of 3 bolts at each connection. Curb to have a factory installed wood nailer. The Rooftop unit must be fastened to the curb and the curb fastened to the structure to resist both seismic and wind forces. Submittal shall include calculations by a professional engineer licensed in the state, and the engineer shall have a minimum of 5 years experience in seismic applications. Curb details and unit connection to curb details shall be included. Curbs shall be type RRC as manufactured by Mason Industries, Inc. Curb shall match slope of the supporting structure.
25. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes 3/4" to 1-1/2" may have threaded two piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi up to 170° F with a uniform drop in allowable pressure to 215 psi at 250° F in sizes through 14". 16" through 24" single sphere minimum ratings are 180 psi at 170° F and 150 psi at 250° F. Higher rated connectors may be used to accommodate service conditions. All expansion joints must be factory tested to 150 % of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints. Expansion joints shall be installed in

pipng gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi maximum on the washer area. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be type SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

26. 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. Minimum lengths shall be as tabulated:

Flanged		
3" x 14"	6" x 20"	12" x 28"
4" x 15"	8" x 22"	14" x 30"
5" x 19"	10" x 26"	16" x 32"
Male Nipples		
1/2" x 9"	1-1/4" x 12"	2" x 14"
3/4" x 10"	1-1/2" x 13"	2-1/2" x 18"
1" x 11"		

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

27. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
28. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. 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 reinsertable to allow for selection of pipe movement. Guides shall be capable of +/- 5/8" motion, or to meet location requirements. Pipe guides shall be type VSG as

manufactured by Mason Industries, Inc.

29. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240° F, 10# density fiberglass may be used in lieu of the sponge. Seals shall be type SWS as manufactured by Mason Industries, Inc.
30. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI / WBD as manufactured by Mason Industries, Inc.
31. Housekeeping pad anchors shall consist of a ductile iron casting that is tapered and hexagonal, smaller at its base than at its top. The upper portion shall have holes for rebar to pass through. The anchor shall be continuously threaded from top to bottom for the attachment of soleplates. Housekeeping pad anchors shall be attached to the structural slab using a stud wedge anchor. Housekeeping pad anchors shall be type HPA and stud wedge anchor shall be type SAS both as manufactured by Mason Industries, Inc.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic 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 herein specified.

- D. The contractor shall not install any equipment, piping, duct or conduit, which 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. Any conflicts with other trades, which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions, should be brought to the architects / engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- G. Bring to the architects / engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- H. Correct, at no additional cost, all installations, which are deemed defective in workmanship and materials at the contractor's expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
 - 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Product specification 13 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Product specification 13 cable assemblies are installed taut on non-isolated systems. Product specification 14 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where product specification 13 or 14 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.
- M. At locations where product specification 13 cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be product specification type 11.
- N. At all locations where product specification 13 or 14 restraints are attached to pipe clevis, the clevis cross bolt must be reinforced with product specification type 16 braces.

- O. Drill-in concrete anchors for ceiling and wall installation shall be product specification type 19, and product specification type 20 female wedge type for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed product specification 25 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide product specification 29 wall seals.
- S. 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 restraint shall be product specification type 30.
- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. All fire protection piping shall be braced in accordance with NFPA 13 and 14.
- V. All mechanical equipment shall be vibration isolated and seismically restrained as per the schedules in part 4 of this specification.
- W. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment in table 1.06-1, if higher levels are shown.
- X. Contractor shall make provisions for attachments of seismic restraints with all required equipment.

3.02 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF PIPING:

- A. Horizontal pipe isolation: The first four pipe hangers in the main lines near the mechanical equipment shall be as described in product specification 12. Brace hanger rods with SRC clamps product specification 15. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in product specification 10 and 11. Floor supported piping shall rest on isolators as described in product specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have 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 three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1-

1/2" deflection for pipe sizes up to and including 6", and 2-1/2" deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Hanger locations that also have seismic restraints attached must have type RW Rebound Washers to limit uplift. Where piping connects to mechanical equipment install product specification 25 expansion joints or product specification 26 stainless hoses if 25 is not suitable for the service.

- B. Riser isolation: Risers shall be suspended from product specification 11 hangers or supported by product specification 5 mountings, anchored with product specification 27 anchors, and guided with product specification 28 sliding guides. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to +/- 25 % of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
- C. Seismic Restraint of Piping:
1. Seismically restrain all piping listed as a, b or c below. Use product specification 13 cables if isolated. Product specification 13 or 14 restraints may be used on unisolated piping.
 - a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1" I.D. or larger.
 - b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1-1/4" I.D. and larger.
 - c. All other piping 2-1/2" diameter and larger.
 2. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 3. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
 5. For fuel oil and all gas piping transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
 6. Transverse restraint for one pipe section may also act as a

longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.
9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly in areas with S_s of 0.35 or greater shall be braced as in sections 3.02.C.2 and 3. For areas with S_s less than 0.35, 2 band clamps may be used with a reduced spacing of 1/2 of those listed in sections 3.02.C.2 and 3.
10. Connection to the structure must be made with a non-friction connection (i.e. no "C" clamps).
11. Hanger locations that also have seismic restraints attached must have Product specification 11 type RW Rebound Washers.
12. Piping which crosses building expansion joints shall be anchored on each side of the expansion joint. Ball joints or braided hose assemblies shall be employed to allow the specified movement of the building without affecting the integrity of the piping system.

D. Pipe Exclusions:

1. Gas piping less than 1" inside diameter.
2. Piping in boiler and mechanical rooms less than 1-1/4" inside diameter.
3. All other piping less than 2-1/2" inside diameter.
4. All piping suspended by clevis hangers where the distance from the top of the pipe to the suspension point is 12" or less.
5. All trapezed piping where the distance from the suspension point to the trapeze member is 12" or less.
6. If any suspension location in the run exceeds the above, the entire run must be braced.

3.03 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF DUCTWORK:

A. Vibration isolation of ductwork:

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of product specification 10 hangers or product specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".
2. All duct runs having air velocity of 1000 fpm or more shall be isolated from the building structure by product specification 12 hangers or 5 floor supports. Spring deflection shall be a minimum of 0.75".

B. Seismic restraint of ductwork:

1. Seismically restrain all ductwork with product specification 13 or 14 restraints as listed below:
 - a. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
 - b. Restrain round ducts with diameters of 28" or larger.
 - c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
2. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
3. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
7. Connection to the structure must be made with a non-friction

connection (i.e. no "C" clamps).

8. Hanger locations that also have seismic restraints attached must have product specification 11 type RW Rebound Washers.

C. Ductwork Exclusions:

1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
2. Oval ducts that are less than 6 square feet in cross sectional area based on nominal size.
3. Round duct less than 28" in diameter.
4. All trapezed ductwork where the distance from the suspension point to the trapeze member is 12" or less.
5. Ductwork hung with straps where the top of the duct is 12" or less from the suspension point and the strap has 2 #10 sheet metal screws within 2" of the top of the duct.
6. If any suspension location in the run exceeds the above, the entire run must be braced.

PART 4 - SCHEDULES

4.01 EQUIPMENT ISOLATOR AND SEISMIC RESTRAINT SCHEDULE:

VIBRATION ISOLATION AND/OR SEISMIC RESTRIANT EQUIPMENT SCHEDULE

	Products	Static Deflection
AHU's/ERU's - Floor Mounted	4, 20	By Manufacturer
AHU's/ERU's - Suspended	11, 13, 15	By Manufacturer
Units Heaters - Suspended	11, 13, 15	None
Fans - Roof Curb Mounted	24	None
Fans - Suspended	11, 13, 15	1"
Ductwork	13, 15	None
Piping	13, 15, 16	None
Housekeeping Pads - All	31	None

Schedule Notes:

- A. Referenced products are list and described in part 2.02 of this specification section.
- B. If static deflection is not listed, then the product does not require resilient mounts, or spring hangers.
- C. Where no specification numbers are listed, the equipment identified still is required to be restrained. Mason Industries will provide engineering

calculations, and details. Mounting hardware will be provided by others.

END OF SECTION 15073

SECTION 15090 SUPPORTS ANCHORS AND SEALS

PART 1 – GENERAL

- 1.1 SCOPE: Provide adequate pipe, duct, and equipment foundation and suspension systems in accordance with recognized engineering practices, using where possible, standard, commercially accepted hangers and accessories.
- 1.2 QUALITY ASSURANCE:
- A. Equipment listed in this section shall be as specified or equal. Firms regularly engaged in manufacturer of supports, anchors, and seals of types and sizes required, whose products have been in satisfactory use in similar service will be considered for approval.
 - B. All pipe hangers and supports shall conform to the latest requirements of the ASA Code for Pressure Piping, B31.1 and Manufacturer's Standardization Society Documents MSS-SP-58 and MSS-SP-69, and ANSI code for pressure piping B31.1.0.
 - C. All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook.
- 1.3 DESIGN:
- A. The Contractor shall be responsible for the pipe and duct supporting systems.
 - B. Where thermal movement in the pipeline will occur, the pipe hanger assembly must be capable of supporting the line in all operating conditions. Accurate weight balance calculations shall be made to determine the supporting force at each hanger in order to prevent excessive stress in either pipe or connected equipment.
- 1.4 DELIVERY, STORAGE AND HANDLING: Deliver all supports, anchors and seals to the job site in original, new and unopened packages bearing manufactures name and label.

PART 2 – PRODUCTS

- 2.1 PIPE HANGERS AND SUPPORTS:
- A. Hanger rods shall be hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turnbuckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread carbon steel rods shall be acceptable.
 - B. Beam Clamps: Equal to Grinnell C-clamp, malleable iron Figure 86 with locknut or Figure 61.
 - C. Pipe Hangers: All hangers for piping shall be provided with means of vertical adjustment.
 - 1) On uninsulated steel pipe, hangers shall be carbon steel clevis type, equal to Grinnell Figures 65 or 260. On piping 2" and smaller, furnish carbon steel hangers with zinc finish equal to Grinnell Figures 69 or 70 swivel ring hangers.
 - 2) On uninsulated copper tubing, hangers shall be carbon steel with copper finish equal to Grinnell Figures CT-69, swivel ring hanger or CT-65 clevis hanger.
 - 3) On insulated piping, hangers shall be carbon steel clevis type equal to Grinnell Figures 65 or 260, and shall be placed on the outside of the insulation with an 18

gauge galvanized shield to distribute the hanger load over the insulation and to eliminate damage to the vapor barrier on the covering.

- 4) Hangers for cast iron soil pipe shall be carbon steel clevis type, equal to Grinnell Figure 590 and Figure 65.
- D. Brackets and Racks: Welded steel brackets shall be equal to Grinnell Figures 194, 195, 199, or as detailed on drawings. Multiple pipe racks or shall be fabricated from channel, angle iron, clamps and accessories, as detailed on drawings.
- E. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Trapeze hangers shall not be permitted for steam supply and return piping.
- 1) Allowable hanger load: Manufacturers rating less 200 pounds.
 - 2) Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, for insulated piping at each hanger.
 - 3) Steam piping will not be permitted on trapeze hangers.
- F. Riser Clamps: Riser clamps shall be carbon steel, equal to Grinnell Figure 261 or carbon steel copper coated CT121. Size riser clamps for actual pipe size in all cases.
- G. For Attachment to Concrete Construction:
- 1) Concrete insert shall comply with Type 18, MSS SP-58.
 - 2) Self-drilling expansion shields and machine bolt expansion anchors shall comply with Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-325.
 - 3) Power-driven fasteners shall be permitted in existing concrete or masonry not less than four inches thick when approved by the Structural Engineer for each job condition. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-325.
- 2.2 COPPER PIPING: Non insulated copper piping supported by a metal framing system, shall be secured to the metal framing by B-Line's B2000 series clamps with B1999 "Vibra Cushion" elastomeric isolator or approved equal. The elastomer shall be rated for -75 degrees F to +375 degrees F operation. Clamp and elastomer shall accommodate pipe and tubing sizes from 1/4" to 8".
- 2.3 METAL FRAMING SYSTEMS:
- A. Provide all metal framing, fittings, and related accessories and labor as indicated to support HVAC equipment, ductwork, piping, controls, etc equal to Unistrut or B-Line.
 - B. All channel members shall be fabricated from structural grade steel conforming ASTM A 570 GR 33 or ASTM A 446 GR A.
 - C. All fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A 575, A 576, A 36 or A 635.

- D. Components shall be finished with rust inhibiting acrylic enamel paint applied by electro-deposition, after cleaning and phosphating, and thoroughly baked.
- 2.4 DUCT HANGERS AND SUPPORTS: Refer to Section 15800.
- 2.5 SLEEVES:
- A. Sleeves in concrete or masonry construction, and where collapse is possible, shall be Schedule 40 pipe, or Type K copper. Other sleeves shall be minimum 22-gauge sheet metal.
 - B. Sleeves accommodating insulated pipe shall be sufficient diameter to pass piping and full size of insulation. Otherwise sleeves shall be two (2) pipe sizes larger than the pipe served.
 - C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1) For sleeves: Extend sleeve one inch above finished floor and furnish and install sealant for watertight joint.
 - 2) For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 - 3) For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
 - D. Furnish and install cast iron pipe sleeves for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
 - E. All sleeves for piping through exterior wall and mechanical rooms shall be sealed.
 - F. Spring clamp plates or set screw escutcheons shall be provided where pipes are exposed in occupied rooms and where walls, floors or ceilings are finished. Plates on extended sleeves shall have chrome-plated skirts.
- 2.6 ESCUTCHEONS: Furnish and install manufactured wall, ceiling, and floor plates to conceal protruding fittings and sleeves. The inside diameter shall closely fit around pipe, tube, and insulation of insulated piping. The outside diameter shall completely cover opening. Escutcheons in concealed spaces shall have a rough brass finish. Escutcheons in exposed spaces shall have a polished chrome plate finish. Escutcheons shall be either one piece or split casing with concealed hinge and set screw.
- 2.7 PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
- 2.8 FLASHING: Piping and ductwork passing through the roof shall be flashed with a galvanized flashing collar and storm collar in accordance with the architectural details.
- 2.9 FIRE-STOPPING:
- A. Fire-stopping materials shall consist of commercially manufactured products complying with the following minimum requirements:
 - 1) Flame Spread Index: Twenty-five or less when tested in accordance with ASTM E84.

- 2) Smoke Density Index: Fifty or less when tested in accordance with ASTM E84.
 - 3) Toxicity: Nontoxic to human beings at all stages of application and during fire conditions.
- B. Fire-stopping materials used to seal penetrations in time-rated assemblies shall be capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 time-temperature fire conditions for either 1 or 2 hours as required.
- C. Fire-stopping materials shall not require a rise in temperature to install or seal.
- 2.10 ROOF CURBS:
- A. Furnish and install pre-fabricated roof curbs where required for roof openings. Prefabricated roof curbs shall have a box section constructed of 18 gauge galvanized steel with continuous welded seams. Curb shall have fully mitered and welded corners, integral water deflecting cricket and shall be insulated with 1-1/2", 3 pcf rigid fiberglass board. Roof curbs shall be internally reinforced on any side longer than 3'-0" and shall have factory installed integral base plate. Height shall be 8" above roof finish rain shed level.
 - B. Contractor field fabricated roof curbs shall not be acceptable.
 - C. Roof curbs for fans and ventilators shall be furnished with equipment.
- 2.11 PIPE FLASHING:
- A. Furnish and install the Deck-Mate, or approved equal, as manufactured by Roof Products and Systems Corporation, at all points where continuous pipes penetrate the roof.
 - B. The pipe flashing shall be constructed of EPDM (Ethylene Propylene Diene Monomer, or Neoprene compression molded rubber material. Material shall have a serviceable temperature range of -60o F to 270o F and be resistant to ozone and ultraviolet rays.
 - C. Unit shall have 1" wide corrosion resistant flexible aluminum base. The base flange shall be incorporated to a pleated expansion joint. Pipe flashing shall accommodate pipes up to 18" in diameter.
- 2.12 EQUIPMENT RAILS: Furnish and install equipment rails equal to Roof Products and Systems Model ER where indicated on the Plans. Prefabricated equipment rails shall be manufactured from 14 gauge galvanized steel. Equipment rails shall have internal reinforcement with an integral base plate, fully mitered and welded corners, a 3" cant, and a factory installed 2 x 4 wood nailer. Height to be 8" above finished roof. Equipment rails shall span a minimum of two joists and not cantilever more than 6". Equipment rails shall be level at the top with pitch built-in when deck slopes 1/4" per foot or greater. Contractor fabricated equipment rails will not be accepted.

PART 3 – EXECUTION

- 3.1 ATTACHING TO STRUCTURE: Where equipment or piping is supported from building steel beams, clamps or welded beam attachments shall be used. Holes drilled in building steel for hanger support rods will NOT be permitted.
- 3.2 HANGER RODS AND SPACING:

- A. Where hanger rod sizes are catalog-listed for a specified hanger, this size shall govern. Where hanger rod sizes are not catalog-listed, the load on the hanger shall be the determining factor and the maximum recommended hanger rod load as catalog-listed, shall govern.
- B. Hangers shall be placed at every change in direction. Pipe hanger spacing shall not exceed:

STEEL PIPING			COPPER PIPING		
PIPE SIZE	SPACING	ROD SIZE	PIPE SIZE	SPACING	ROD SIZE
1/2" to 3/4"	5'	3/8"	1/2" to 1"	6'	3/8"
1" to 2"	7'	3/8"	1-1/4" to 2"	10'	3/8"
2-1/2" to 3"	11'	1/2"	2-1/2" to 3"	12'	1/2"
4" to 5"	14'	5/8"			

3.3 AUXILIARY STEEL:

- A. Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment. Material members shall be consistent with that of the main structural system.
- B. Torch cut ends of auxiliary steel shall be ground to a smooth surface finish. Welding shall comply with AWS D.1.1 "Structural Welding Code – Steel".
- C. Arrange for any adjustment necessary in main structural system for proper support of major equipment.
- D. All auxiliary steel shall be finished with one shop coat of primer paint. After fabrication and erection, welds shall be painted with an additional primer coat.

3.4 METAL FRAMING INSTALLATION:

- A. Installation shall be accomplished by a fully trained manufacturer authorized installer.
- B. Set framing components into final position true to line, level and plumb, in accordance with approved shop drawings.
- C. Anchor materials firmly in place. Tighten all connections to their recommended torques.

3.5 CONCRETE PADS:

- A. Provide concrete pads under all floor-mounted equipment and apparatus as described on drawings. Construct concrete bases of dimensions indicated, but not less than six inches larger in both directions than supported unit.

- B. All pads for pumps shall be a nominal 8" thick unless otherwise noted on the drawings. All pads for air handlers with base rails shall be a nominal 8" thick unless otherwise noted on the drawings. All pads for air handlers without base rails shall be a nominal 12" thick unless otherwise noted on the drawings. All remaining equipment shall set on 4" thick concrete pads.
- C. Concrete pads for reciprocating action equipment shall be pin anchored to concrete slab.
- D. The Contractor shall provide all necessary anchor bolts, together with templates for holding bolts in position.

3.6 SLEEVES AND PLATES:

- A. Sleeves shall be used where piping passes through exterior walls, floor or roofs; where required for sealing to meet any sanitation codes, ordinances or laws; and areas where water may accumulate.
- B. In toilets, equipment rooms and other areas where water may accumulate on the floor, sleeves shall extend 1" above the finished floor. Other sleeves shall be flush with finished floor.
- C. After all piping has been inserted in sleeves, voids between pipe or insulation and sleeve shall be filled with a suitable non-run, non-stain elastomeric mastic.
- D. Riser clamps on chilled water piping shall be raised above the floor level a minimum of 2" with auxiliary steel attached to riser clamp to allow insulation of riser clamp.
- E. Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1) Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2) Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3) Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

3.7 ESCUTCHEONS: Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

- A. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
- B. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
- C. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
- D. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
- E. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

3.8 PAINTING AND PRIMING: Paint all piping and hangers exposed in finished areas or outside as directed in Section 09900.

3.9 FIRE-STOPPING:

- A. Install a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and to maintain the integrity of the time rated construction. Fire-stopping shall be provided in, but not limited to, the following locations:
 - 1) Duct and pipe penetrations through above grade floor slabs and through time-rated partitions and fire walls.
 - 2) Penetrations of vertical shafts such as pipe chases.
 - 3) Other locations where indicated by drawings or required by code.
- 3.10 ROOF CURBS: Install pre-manufactured roof curbs in accordance with manufacturer's instructions.
- 3.11 PIPE MOUNTING PEDESTALS: Install pre-manufactured pipe mounting pedestals in accordance with manufacturer's instructions.
- 3.12 ROOF MOUNTED PIPE SUPPORT SYSTEM:
 - A. Verify that roofing system is complete, and that roof surfaces are smooth and flat and are ready to receive work.
 - B. Verify that roof temperature is a minimum of 60 degrees F for proper adhesive performance.
 - C. Use care in installation of pipe support systems not to damage roofing, flashing, equipment or related materials.
 - D. Clean surfaces of roof to receive pipe support bases. Remove gravel from gravel surfaced roofs, remove dirt, dust, oils, and other foreign materials from all roofs. Prime existing membrane with a primer that is compatible with existing components in the roofing system.
 - E. Bases and support framing shall be located as indicated on drawings and as specified herein. The support of all piping shall be complete and adequate, whether or not all required devices are shown.
 - F. Set bases with adhesive in accordance with manufacturer's installation instructions. Accurately locate and align bases. Where applicable, replace gravel around bases. Install strut framing as indicated by pipe system manufacturer's instructions.
- 3.13 DUCT MOUNTING PEDESTALS: Install pre-manufactured duct mounting pedestals in accordance with manufacturer's instructions.

END OF SECTION 15090

SECTION 15200 NOISE VIBRATION AND EXPANSION

PART 1 – GENERAL

- 1.1 SCOPE: It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration and noise to the building structure. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements of the specifications.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15060 - PIPE AND PIPE FITTINGS; 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; 15600 - HVAC EQUIPMENT; and 15800 - AIR DISTRIBUTION.
- 1.3 QUALITY ASSURANCE:
- A. All vibration isolation devices shall be designed and furnished by a single manufacturer or supplier. All vibration isolation and noise control devices shall be designed to meet the requirements of latest edition of ASHRAE Systems Handbook. Equipment shall be of the type specified herein or appeared equal.
- B. Noise Criteria:
- 1) Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room.
 - 2) For equipment which has no sound power ratings scheduled on the plans, the Contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with the latest edition of ASHRAE Systems Handbook, SOUND AND VIBRATION CONTROL chapter. An average value of 5 db shall be used as the room attenuating effect, i.e., the difference between sound power level emitted to room and sound pressure level in room.
 - 3) In absence of specified measurement requirements, measure equipment noise levels three (3) feet from equipment and at an elevation of maximum noise generation.
- C. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20-inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.
- 1.4 SUBMITTALS: Submit for approval all isolation and expansion specialties under this section of the specifications. Submittal data shall indicate type, size and deflection of each isolator.
- 1.5 DELIVERY, STORAGE AND HANDLING: Deliver all equipment to the job site in original, new and unopened packages bearing manufactures name and label.

PART 2 – PRODUCTS

- 2.1 ELASTOMERIC ISOLATOR: Furnish and install in sufficient quantities, where indicated on the drawings or required to reduce vibration and noise, elastomeric isolators equal to Amber-Booth NR series 3/8" thickness, ribbed neoprene pads. Elastomeric isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness

- of 60 durometer and have a straight-line deflection curve. Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed. Color code isolator by type and size for identification of capacity.
- 2.2 RUBBER-IN-SHEAR ISOLATOR: Furnish and install in sufficient quantities, where indicated on the drawings or required to reduce vibration and noise, isolators equal to Amber-Booth RV series rubber-in-shear vibration isolators with nominal 1/4" deflection.
- 2.3 RUBBER-IN-SHEAR EQUIPMENT HANGERS: Furnish and install where indicated on the drawings or required to reduce vibration and noise, equipment hangers equal to Amber-Booth HRD series, steel hanger with double deflection type neoprene grommet mount having a nominal 1/4" deflection.
- 2.4 SPRING EQUIPMENT HANGERS: Furnish and install where indicated on the drawings or required to reduce vibration and noise, equipment hangers equal to Amber-Booth BSR series having a nominal 1" deflection. Spring shall be 2" O.D., mounted in a rectangular steel box capable of 200 % minimum overload, with spring retainers, neoprene impregnated fabric washer and steel washer. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 30 degree angular misalignment without rubbing on hanger box.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Provide structural and other equipment required to control expansion and contraction of piping, loops and offsets. Rigidly anchor pipe to building structure. Where necessary provide pipe guides so that movement takes place along axis of pipe only.
- B. Provide all necessary auxiliary steel for proper operation and installation of isolation equipment.
- C. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise.
- D. Vibration Isolation:
- 1) No metal-to-metal contact will be permitted between fixed and floating parts.
 - 2) Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports.
 - 3) Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
 - 4) Provide heat shields where elastomers are subject to temperatures over 100° F.
 - 5) Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.

- E. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.
- F. Where excessive noise is generated in a piping system, due to arrangement or velocity of the fluid within the pipe, the Contractor shall, at his expense, make modifications as required or as directed by the Engineer to reduce noise to an acceptable level.

END OF SECTION 15200

SECTION 15250 MECHANICAL SYSTEMS INSULATION

PART 1 – GENERAL

- 1.1 SCOPE: Furnish and install insulation, coverings and sealants for equipment, piping and ductwork as specified and shown on the drawings.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; 15600 - HVAC EQUIPMENT; and 15800 - AIR DISTRIBUTION.
- 1.3 QUALITY ASSURANCE:
 - A. Insulation shall be manufactured in accordance with ASTM, UL and NFPA standards and meet the requirements of a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Insulation shall be of the type specified herein or approved equal.
 - B. Installer: A firm with at least five (5) years of successful installation experience on projects with work similar to this project.
- 1.4 SUBMITTALS: Submit for approval product data sheets on all insulation, material safety data sheets, and a written description of methods and thickness intended for insulating all piping services and ductwork, including but not limited to insulation types and thickness for each service and associated materials including but not limited to; vapor retarders, mastics, jackets and covers and sealing tape.
- 1.5 DELIVERY, STORAGE & HANDLING: Deliver all materials to the job site in original, new and unopened packages bearing manufacturers name and label. Store insulation and accessories inside building in a designated area clean from other trades. Protect insulation against dirt, water and damage. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 – PRODUCTS

- 2.1 MATERIALS:
 - A. Fiberglass (Mineral Fiber) Pipe Insulation: Thermal conductivity shall be no greater than 0.23 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C547 and rated for 0o to 850o F. Pipe insulation shall be furnished with factory applied white all service (ASJ) vapor barrier jacket with self-sealing lap (ASJ-SSL). Fittings shall be pre-molded from same material. Fiberglass pipe insulation shall be equal to Owens - Corning "Fiberglas SSL II".
 - B. Flexible Elastomeric Cellular Insulation: Thermal conductivity shall be no greater than 0.27 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C534, and rated for a maximum service temperature of 200o F. The flame spread rating shall be less than 25, and smoke developed rating shall be less than 50, equal to Armstrong AP Armaflex.
 - C. Fiberglass (Mineral Fiber) Duct Insulation Board: Thermal conductivity shall be no greater than 0.23 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C177 and rated for -20o to 450o F. Duct insulation shall be furnished with a two (2) mil foil scrim kraft vapor barrier (FSK) and have a density of three (3) pcf. Insulation board shall be equal to Knauf.

- D. Fiberglass (Mineral Fiber) Duct Insulation Wrap: Thermal conductivity shall be no greater than 0.36 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C177 at twenty-five (25) percent compression. Insulation shall be rated for -20o to 450o F. Duct insulation shall be furnished with a two (2) mil foil scrim kraft vapor barrier (FSK) and have a density of 0.75 pcf. Insulation wrap shall be equal to Knauf.

2.2 PLUMBING:

- A. Evaporator (Cooling Coil) Condensate Drain Line: Insulate pipe including P-trap and trap arm with 1" inch thickness fiberglass insulation.

2.3 HVAC:

- A. Above Grade Pipe Insulation (Flexible Elastomeric Cellular):

- 1) Insulate refrigerant suction piping (indoors) and humidity condensate drains with 1" thickness elastomeric insulation.
- 2) Insulate refrigerant suction piping outdoors with 1" inch thickness elastomeric insulation.

- B. Ductwork:

- 1) The following square and rectangular ductwork within mechanical rooms shall be externally insulated with 1" inch thick rigid fiberglass board or semi rigid tank wrap.
 - a) Supply Air Ductwork
 - b) Return Air Ductwork
 - c) Outside Air Ductwork
- 2) All supply, return and outside air ductwork above ceilings shall be insulated with 2" inch thickness fiberglass duct wrap.
- 3) The top of all supply grilles shall be insulated with 2" inch thickness fiberglass duct wrap.
- 4) Supply air ductwork on the roof shall be insulated with 2" inch thickness rigid fiberglass board or semi rigid tank wrap.
- 5) External ductwork insulation shall be factory labeled at intervals not greater than 36" inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

2.4 MISCELLANEOUS MATERIALS:

- A. Jacketing:

- 1) Exterior Piping: Aluminum jacketing shall be constructed of smooth 0.016 inch thickness ASTM B 209, Alloy 3003, H14 temper aluminum. All ell covers shall be two (2) piece, factory fabricated type, made of 0.020 inch thick 3003 sheet aluminum. Bands shall be 3/8" wide, 0.015" inch thickness aluminum up to 8" inch diameter pipe and 3/4" wide, 0.015" inch thickness aluminum on pipes sizes larger than 8" inch diameter.

- B. Mechanical Fasteners:

- 1) Weld-Attached Anchor Pins and Washers: Copper coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated. Welded pin holding capacity shall be a minimum 100 lb for direct pull perpendicular to the attached surface.
 - 2) Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 3) Staples: Outward clinching monel or stainless steel.
 - 4) Wire: 18 gage soft annealed galvanized, or 14 gage copper clad steel or nickel copper alloy.
 - 5) Bands: 3/4" inch nominal width, brass, galvanized steel, aluminum or stainless steel.
- C. Reinforcement and Finishes:
- 1) Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
 - 2) Hexagonal wire netting: 1" inch mesh, 22 gage galvanized steel.
 - 3) Corner beads: 2" inch by 2" inch 26 gage galvanized steel; or 1" inch by 1" inch 28 gage aluminum angle adhered to 2" inch by 2" inch Kraft paper.
- D. Tapes:
- 1) Metallic Sealing Tape: Aluminum tape shall be 3" inch width (minimum) with 15 mils of elastomeric modified butyl adhesive on two (2) mil foil backing. Tape shall comply with UL 181B-FX and shall be equal to Hardcast "Foil Grip".
 - 2) Tape for Flexible Unicellular Insulation: Scotch No. 472, Nashua PE 12, or approved equal recommended by the insulation manufacturer.
 - 3) Glass Fiber Fitting Tape: Mil. Spec. MIL C 20079, Type II, Class 1.

PART 3 – EXECUTION

3.1 GENERAL:

- A. The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner, with jackets and facings drawn tight and smoothly cemented at all laps. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes and industry standards.
- B. On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Provide semi-circular protection saddles of #18-gauge galvanized steel, 12" long, for insulated piping where hangers occur. On pipe sizes 3" and over, provide pressure treated wood blocking matching insulation thickness, at hangers. Steel protection saddles shall be used at steam piping. Space between pipe and roller hanger inside saddle shall be insulated.

- D. Insulation shall be continuous through walls, ceiling or floor opening, or sleeves; except where firestop or fire saving materials are required.
- E. All exposed ends of pipe insulation shall be pointed up neatly with appropriate insulating cement.
- F. Piping and ductwork systems shall be tested and cleaned before insulation is applied.
- G. All insulated piping exposed to weather, shall be protected by an aluminum jacket. Jacket shall overlap not less than 2" inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12" inch centers. Longitudinal joints shall be overlapped down to shed water. Circumferential joints shall be sealed with a coating recommended by the insulation manufacturer for weatherproofing seams and joints in aluminum jackets. All ell covers shall be secured with adjustable metal bands on 18" inch centers. All screws used on aluminum jackets and fittings shall be stainless steel with neoprene gaskets. The heads of screws shall be covered with GE RTV silicone. Install aluminum angle ring escutcheons at wall penetrations.

3.2 INSTALLATION:

- A. Pipe and Fittings with Fiberglass Insulation:
 - 1) Locate all seams in the least visible location for exposed pipe. All piping below ambient temperatures shall be installed with a continuous vapor barrier. All joints, seams and fittings shall be sealed. All ends must be firmly butted and secured with appropriate butt strip material. All ends cut for termination of insulation shall be completely sealed. On high temperature piping (200o F and higher) apply double layer with staggered joints of strip material. Elbow fittings shall consist of heavy-density molded factory fitting insulation or mitered fitting insulation, covered with a vapor seal of glassfab and mastic or PVC cover. Diaper type low density insulation will not be acceptable.
 - 2) Linear voids of flexible pipe connectors shall be built up to a smooth contour to the limits of the high point of the adjoining flange or union fitting with continuous wrappings of insulation material secured in place by copper wire ties. Complete assembly shall then be covered by a continuous wrap vapor barrier material. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2" overlap to tape or mastic.
 - 3) Valves and fittings on all piping shall be completely insulated with fiberglass block insulation. Vapor retarders shall overlap a minimum of 2" at all seams and be sealed with appropriate pressure sensitive tape or mastic. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2" overlap to tape or mastic.
 - 4) All cut openings or other penetrations on insulated pipes for pressure gauges, thermometers, pressure and temperature plugs, flow switches, pressure sensors, temperature sensors, etc. shall be sealed vapor tight. Sufficient layers of waterproof mastic shall be applied to avoid water ponding and damage to insulation.
 - 5) Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 3/4" inch

and smaller shall not be insulated. Insulate piping to within 3" inches of un-insulated devices.

- 6) For flanges on piping conveying fluids 60o F or below:
 - a) Apply pipe insulation to outer diameter of pipe flange.
 - b) Width of insulation segment shall be the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - c) Voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments shall be filled with cut sections of sheet insulation of the same thickness as pipe insulation.
 - d) Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage to air to the pipe surface.
 - 7) Direct expansion piping shall be vapor sealed and completely insulated to the coil connection.
 - 8) Self-sealing laps may be used provided the lap seal is additionally sealed with a vapor barrier mastic.
- B. Pipe and Fittings with Elastomeric Insulation:
- 1) Install the proper size insulation, do not stretch or strain insulation. Where possible, slip insulation over the pipe or tubing prior to connection, and brush a light coat of manufacturer's recommended adhesive (equal to Armstrong 520) to all seams and butt joints. Insure all seams are fully covered with adhesive and the surface nearest the pipe pressed together first and evenly before joining the entire surface.
 - 2) For all exterior piping, apply manufacturer's recommended adhesive, equal to Armstrong 520, one (1) layer of fiberglass fabric and two (2) coats of white pigmented acrylic latex, equal to Armaflex WB finish. Allow bonded glass mesh to dry one (1) hour before application of weatherproof finish.
 - 3) On all runouts with elastomeric pipe insulation, brush a light coat of manufacturer's recommended adhesive to both surfaces and allow the adhesive to set until dry to the touch. All seams and butt joints must be fully covered with adhesive and the surface nearest the pipe should be pressed together first and evenly before joining the entire surface.
- C. Ductwork:
- 1) External Board Insulation: Secure board insulation with adhesive and anchor pins and speed washers.
 - a) External board insulation on square and rectangular ducts shall be attached with welded pins conforming to SMACNA MF-1-1971 secured by adhesive conforming to ASC-A-2001A-1971.
 - b) Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 - c) Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

- d) Space anchor pins as follows:
 - i. On duct sides with dimensions 18" inches and smaller, along longitudinal centerline of duct. Space 3" inches maximum from insulation end joints, and 16" inches o.c.
 - ii. On duct sides with dimensions larger than 18" inches: Space 16" inches o.c. each way, and 3" inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - iii. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - iv. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces.
 - 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.
 - f) All joints and breaks in facing shall be sealed with 3" wide, 0.002 aluminum foil scrim facing pressure sensitive tape.
 - g) Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - h) Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6" inches o.c.
 - i) Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- 2) Duct Wrap: Secure blanket insulation with adhesive and anchor pins and speed washers.
- a) Install duct wrap to obtain specified R-value using maximum compression of 25 %. Pull jacket tight and smooth. Install thickness in accordance with the specifications.
 - b) Impale insulation over anchors and attach speed washers. 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.
 - c) Create a facing lap for longitudinal seams and end joints with insulation by removing 2" inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2" inch staples, 1" inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 - d) Overlap unfaced blankets a minimum of 2" inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18" inches o.c.

- e) Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - f) Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6" inches o.c.
 - g) All seams shall be sealed with pressure-sensitive tape matching the insulation facing. Seal all tears, punctures, and other penetrations of the duct wrap facing with tape or mastic to provide a vapor-tight system.
 - h) Pressure sensitive tapes shall be a minimum 3" inches wide and applied with a moving pressure using an appropriate tool as recommended by the manufacture.
 - i) On flat surfaces over 18" inches wide, duct wrap shall be additional secured to the bottom of the ductwork using mechanical fasteners on 18" inch centers, without over compression of the insulation.
- 3) Ductwork in mechanical rooms and exposed duct shall be covered with an eight (8) ounce canvas material sized with a lagging adhesive meeting NFPA 90A flame and smoke requirements.
- D. Duct liner shall be adhered to the sheet metal plenum with 100 % coverage of adhesive conforming to ASC-A-7001A-1971. All exposed leading edges and transverse joints shall also be coated with adhesive. Mechanical fasteners conforming to SMACNA MF-1-1971 shall be used to additionally secure the duct liner. Fasteners shall be installed within 3" of edges and maximum 12" on centers.
- E. Protect outdoor duct insulation from weather by installing a weather-barrier mastic protective finish. Insulation shall be applied with an adhesive recommended by the insulation manufacturer, at a rate of one (1) per two (2) square feet of surface area on ductwork, transitions, silencers etc. After adhesive has dried, insulation board shall be impaled onto hangers and secured by speed clips. A weatherproof mastic equal to Lion Oil Company's "Seal Kote", 1/16" minimum thickness, shall be applied to the surface of the ductwork. A layer of glass fiber reinforcement shall then be applied. A final trowel grade of mastic, 1/16" minimum thickness, shall be then be applied. Protect mastic coating by installing an aluminum jacket.

END OF SECTION 15250

SECTION 15400 - PLUMBING EQUIPMENT

PART 1 - GENERAL

- 1.1 SCOPE: Furnish and install all fixtures, equipment and specialties shown on the plans or specifications. Provide all necessary supports, trim and accessories required.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15060 - PIPE AND PIPE FITTINGS; 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; and 15250 - MECHANICAL SYSTEMS INSULATION.
- 1.3 QUALITY ASSURANCE: All equipment, fixtures and trim shall be manufactured to meet all applicable ANSI, Federal Specifications, and UL requirements. Equipment and fixtures shall be as specified herein or equal.
- 1.4 SUBMITTALS: Submit for approval product data sheets on all equipment, fixtures and trim specified in this section of the specifications.
- 1.5 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver plumbing equipment and fixtures individually wrapped in factory fabricated containers.
 - B. Handle plumbing equipment and fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing equipment or fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

- 2.1 FIXTURES:
 - A. Fixtures shall be non-absorbent throughout and free from waves, film marks or discoloration. All surfaces coming in contact with walls, floors or other flat surfaces shall be flat.
 - B. All enameled ironware shall be acid resisting. All exposed finished metal parts shall be chromium plated; except, rough-bodied parts shall be nickel-plated.
 - C. All supplies shall be I.P.S. brass; except, where otherwise specified. All fixtures shall be provided with some form of supply stop. Traps for lavatories and sinks shall be chrome-plated cast brass P-traps with cleanout.
- 2.2 DOMESTIC WATER HEATERS:
 - A. DOMESTIC WATER HEATERS (WH-1):

- 1) Domestic water heaters shall be of the vertical, cross-flow, 2-pass, semi-instantaneous type, having service water in the shell and steam in the coils.
- 2) The heat exchanger shall be configured for condensate subcooling such that no condensate leaves the unit at a temperature in excess of 160 deg. F regardless of inlet steam pressure when the temperature of the incoming cold water is 110° F or less.
- 3) Domestic water heaters shall be furnished with 1-1/2" insulation, bronze T & P relief valve, shell drain valve, condensate outlet union orifice, condensate swing check valve, pneumatic control valve, and self-contained temperature control system.
- 4) Control system shall consist of a integral demand anticipator, dual solenoid valve, dynamically balanced pneumatic temperature controller with Class VI ANSI standard seating, over-temperature limit system, power on and tripped status lights, remote capillary thermometer, and compound steam gauge. Control system shall regulate the final temperature within +/- 4 deg. F of the desired temperature at all domestic load conditions.
- 5) Heat exchanger shall be constructed of multiple, individually replaceable, helically wound coils. Coils shall be capable of withstanding up to 30" w.c. internal vacuum. Each coil shall automatically and independently self-descale. Heat exchanger design shall be suitable for cleaning by method of thermal shock.
- 6) Water vessel shall be designed to allow no greater than one (1) FPS average velocity through the shell at design flow conditions to ensure no heat exchanger erosion. Total domestic water pressure drop through the heat exchanger shall no exceed one (1) psi at design flow. Water vessel shall be designed and manufactured in accordance with ASME Section VIII, Div 1 for no less than 235 psig at 400 deg. F working pressure and temperature.
- 7) Pressure vessel and heat exchanger surfaces in contact with the domestic water shall be copper or copper alloy. Materials of construction shall be 3/16" carbon steel shell with solid sheet copper liner, 0.065" wall copper coils, Schedule 80 red brass steam and condensate risers, and bronze top and bottom heads.
- 8) Domestic water heaters shall be rated for the water flows, temperature rise, steam flow, and steam pressure indicated on the Drawings.

2.3 HOSE BIBBS:

- A. Freeze Proof Hose Bibbs (HB-1) shall be equal to Woodford Model 65, 3/4" size, with chrome finish brass casting face, backflow preventer, union elbow inlet, wall clamp and key handle.

2.4 TRAPS AND DRAINS:

- A. General: Deep seal P-traps shall be placed under all floor drains and where indicated in wastes and at other points indicated on plans. P-traps shall be heavy cast iron bell and spigot pattern.

2.5 WATER HAMMER ARRESTORS: Furnish and install water hammer arrestors equal to Wade "Shokstops". Water hammer arrestors shall be sized in accordance with Plumbing and Drainage Institute Standard PDI-WH201 and American Society of Sanitary Engineering Standard ASSE-1010. Bellows and casing shall be constructed of stainless steel. Maximum working pressure shall be 250 PSIG. Temperature range shall be from -100° F to +300° F.

PART 3 - EXECUTION

3.1 FIXTURES:

- A. All fixtures subject to damage prior to completion of building shall be protected in an approved manner. Job must be turned over to Owner with all fixtures clean and free from damage.
- B. Unless specifically specified to be furnished with chair carrier, wall hung lavatories, sinks, etc., shall be secured to wall with back-up plate and threaded rods. The Contractor shall furnish and install all backing, reinforcing, hangers, bolts, anchors and brackets required.
- C. Fixtures shall be installed in accordance with manufactures recommendation. Fixtures mounted on uneven surfaces shall be bedded in an approved manner.

3.2 FREEZE RESISTANT DRINKING FOUNTAIN: Unit shall have pneumatic operated valves and shall be installed below frost line to drain water to non-freezing depth. Five (5) cubic feet of porous gravel fill shall be required for water left in supply line between valve and bubbler when valve is in off position to drain through check valve into ground.

3.3 CLEANOUTS:

- A. Cleanouts shall be provided at the ends and at points in change of direction of all drain, soil, waste pipes and branches thereof, at the foot of each riser, at all offsets, in all horizontal runs at approximately 50' intervals, and at other points where indicated on plans or where required.
- B. All cleanouts in connection with cast iron pipes, except the traps and fittings on horizontal branches, shall have tapped "Y" fittings of same size as pipe up to 4", and 4" for all larger pipe, closed with screw plugs. All other cleanouts in connection with cast iron pipe, except those that occur in finished floors and walls shall have heavy cast iron ferrules same sizes as pipe up to 4", and 4" for all larger pipe, caulked into hub, and closed with a screw plug.

- 3.4 FLOOR DRAINS: Install floor drains for area drainage use flush and level with finish floor. Install floor drains used in shower pans with clamping collar above floor elevation and strainer at tile elevation.
- 3.5 WATER HAMMER ARRESTORS: Install shock absorbers as indicated on Drawings or as a minimum at each hot and cold line drop to fixture batteries. Shock absorbers shall be sized as recommended by the manufacturer.

END OF SECTION 15400

SECTION 15500 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL

- 1.1 SCOPE: Work shall include all necessary parts, equipment and labor to provide a complete wet fire protection system as specified and shown on the drawings. Design and installation shall comply to the requirements of NFPA, IBC, FM, and OSHA. The specifications and drawings set minimum performance and provide a guide for the Contractor to design and layout the sprinkler system. The Contractor shall verify design flows and conditions with the local authority having jurisdiction for the purposes of bidding and designing the sprinkler system. All applicable codes and NFPA standards shall be followed. In the event that a code conflict occurs, the most stringent requirement shall apply. The sprinkler system shall be hydraulically calculated as per NFPA and FM. Each system shall have a minimum safety factor of 10 PSI. EXCEPTION: Standpipe calculations to be provided as per local authority having jurisdiction requirements. Velocity for under ground piping shall comply to the requirements of NFPA and FM. Provide pressure-reducing devices or pressure restricting devices on all valves as required by NFPA, FM, and IBC. Fire sprinkler contractor shall pay for all permits, fees, licenses, patents and certificates of approval.
- 1.2 QUALITY ASSURANCE: All work shall be done in accordance with Owner's insurance carrier's requirements, NFPA requirements and all applicable local and state codes and ordinances. The sprinkler system designer shall have obtained NICET Level 3 certification in fire sprinkler design prior to designing the system(s). The contractor shall be licensed to perform fire protection work within State of Arkansas as per the requirements of the Arkansas Fire Protection Licensing Board. Equipment specified herein shall be as noted or equivalent. The sprinkler Contractor shall coordinate with other trades on the job in locating the sprinkler system in relation to lights, steel framing, building HVAC system, etc. The Contractor shall, after completion of the work, make any corrections to the system as required for approval by the insurance carrier, the Engineer and the local authority having jurisdiction. In order to expedite sprinkler system design and upon mutual agreement, Insight Engineering may assist sprinkler contractor in the development of "working plans". However, the sprinkler contractor shall satisfy all code, fabrication, coordination, and AHJ requirements.
- 1.3 SUBMITTALS:
- A. Submit shop drawings on all equipment, hydraulic calculations and detailed drawings on the proposed system to the Architect through the general contractor and to the local authority having jurisdiction for approval.
 - B. Submit plans and hydraulic calculations as per the requirements of NFPA 13. The sprinkler contractor shall be required to receive reviewed and approved drawings from all AHJ prior to commencing fabrication or installation. Partial submittals are not acceptable.

- C. Coordinate the index sheet of the material submittal to coincide with the arrangement of the product specification order as shown in this division. This will expedite the review process.
- 1.4 COORDINATION: All work shall be designed and installed in accordance with the local utility company requirements. Contractor shall submit plans and specifications to all AHJ and receive approval prior to installation. Failure to receive approval prior to installation, see quality assurance section.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION PIPING AND FITTINGS:

- A. Above ground fire protection wet piping shall be Schedule 10 roll grooved black steel meeting all NFPA 13 and Factory Mutual requirements or Schedule 40 threaded or groove black steel meeting all NFPA 13 and Factory Mutual requirements. Above ground fire protection dry, deluge, and pre-action piping shall be Schedule 10 roll grooved galvanized steel meeting all NFPA 13 and Factory Mutual requirements or Schedule 40 threaded or groove galvanized steel meeting all NFPA 13 and Factory Mutual requirements. All pipe end preparations shall meet the requirements of NFPA 13.
- B. Flange fittings around the fire pump shall be standard class 125 cast iron on the pump suction or extra heavy class 250 (if required by pump discharge pressure) cast iron on the pump discharge. Black grade groove fittings and couplings for wet systems and galvanized for dry, deluge, and pre-action systems shall be installed. All groove couplings shall be UL / FM approved for 500 PSI working pressure. The use of groove reducing couplings with a maximum working pressure of 350 psi is acceptable on wet systems only. Groove couplings installed on all dry systems and pre-action systems shall utilize the "flush seal" type gaskets. Fittings and couplings for screwed pipe shall be standard class cast iron 125. No groove fitting that has a "short" take out nor the accompanying coupling, will be acceptable. No press-fit or sock it type fittings will be acceptable. All groove fittings to be of the same manufacturer. Installer is cautioned to NOT mismatch groove material. Welded outlets on piping shall comply the requirements of ANSI B1.20.1; ASTM A-53, Grades A or B, Type E. Welded outlets to be UL listed, FM approved for use conforming to NFPA. NOTE: The outlet type used shall match the pipe type installed. For example, a Schedule 40 pipe shall have a Schedule 40 welded outlet and a Schedule 10 pipe shall have a Schedule 10 outlet. Segment welded fittings are not acceptable.
- C. Underground fire protection and lead in piping shall be ductile iron class 50, 51, or 52 conforming to the latest revision of ANSI / AWWA C151 / A21.51. Pipe shall have standard asphaltic coating on the exterior. Pipe shall also have a cement-mortar lining on the interior in accordance with ANSI / AWWA C104 / A21.4, of latest revision. Install pipe as specifically required by the manufacturer, NFPA 24, and all AHJ. Consult local AHJ for underground material, means, and methods.

- D. Underground fittings shall be cement lined ductile iron mechanical joint conforming to ANSI / AWWA C104 A21.4 of latest revision. Install fittings as specifically required by the manufacturer, NFPA 24, and all AHJ.
- E. CPVC Piping: Shall be equivalent to Tyco Fire Products "BLAZEMASTER" manufactured as per ASTM F-442, SDR 13.5. Design and installation of piping to be in strict accordance to the specifications of the manufacturer and NFPA.
- F. CPVC Fitting: Shall be equivalent to Tyco Fire Products "BLAZEMASTER" manufactured as per ASTM F-438, for Schedule 40 and ASTM F-439 for Schedule 80. Design and installation of piping to be in strict accordance to the specifications of the manufacturer and NFPA.
- G. Copper tubing having a wall thickness of Type K shall be used from a point of approximately 1'-0" outside the MRI Room. The sprinkler contractor shall penetrate the RF shield one (1) time by use of the wave guide provided by the MRI manufacturer and install Type K copper throughout the MRI Room for the fire sprinkler system.
- H. Copper fittings conforming to ASME B16.18 shall be provided for copper tube connections. This is a cast copper alloy solder joint pressure fitting.

2.2 VALVES:

- A. Gate Valve (above grade): Valves 2" and smaller shall be made of the best grade brass of screwed pattern, solid wedge disc, outside, screw and yoke, screwed bonnet and malleable iron wheel, Nibco T-104-O 175 lb. non-shock or approved equivalent.
- B. Flange End O. S. & Y. Gate Valves: Valves 2-1/2 " and larger shall be cast iron body, cast iron wheel, bolted bonnet, outside screw-and-yoke, solid wedge disk, parallel seat, Nibco F-607-OTS 175 lb. non-shock or approved equivalent. All valves shall have UL / FM approval stamped on valve.
- C. Non-Rising Stem Gate Valves: Valves shall be equivalent to Nibco F-609 or M-609. UL / FM / ULC approved, cast iron body, bolted bonnet, solid wedge disk, and parallel seat.
- D. Indicator Post: Shall be of the same manufacturer as the non-rising stem gate valve. Post shall be equivalent to Nibco NIP-2AJ wall post or Nibco NIP-1AJ upright post. Indicator post to be UL / FM / ULC approved, body of ductile iron, with steel operation rod, bronze stem, and cast aluminum target plates ("open" and "shut").
- E. Groove End Butterfly Valves: Valves shall be equivalent to Tyco Fire Products Model BFV-1 with built in tamper switch. Maximum working pressure 300 PSI, UL / FM / ULC approved, and ductile iron body having epoxy coating. Ductile iron disk, disk seal of grade EPDM type E encapsulated rubber conforming to ASTM D-2000. Both upper stem, lower plug, and stem to be stainless steel.

- F. Groove End Check Valves: Valves shall be equivalent to Tyco Fire Products Model CV-1F. Maximum working pressure 300 PSI, UL / FM / ULC approved, ductile iron body and cap with stainless steel clapper.
- G. Screw Check Valves: Valves 2" and smaller shall be UL / FM approved made of brass, screwed pattern, horizontal swing, Y-pattern, renewable composition disc, equivalent to Nibco KT-403-W, 200 lb. WOG non-shock.
- H. Flange End Check Valves: Valves 2-1/2" and larger shall be UL / FM approved horizontal swing, iron body, bronze trim, bolted bonnet, bronze disc, flanged ends, equivalent to Nibco F-968-B, 250 lb non-shock.
- I. Globe Valves and Angle Valves: Valves shall be UL / FM approved made of brass, screwed pattern, EPDM type W disk, screwed bonnet, and aluminum wheel, Nibco KT-211-W-UL or KT-67HL 175 lb. WOG non-shock or approved equivalent.
- J. Dry Pipe Valves: Valves 4" and 6" shall be equivalent to Reliable Model D. UL / FM / ULC approved with working pressure pf 175 PSI, flange to mate with ANSI B 16.1 flange and groove per ANSI / AWWA C606. Install Reliable Model D galvanized trim kit, which is to incorporate an electric sprinkler alarm switch.
- K. Alarm Check Valves: Valves shall be equivalent to Reliable Model E with Model E-3 variable pressure trim set and Model E-1 retard chamber. For grid systems provide a pressure relief kit.
- L. Pressure Regulating Valves for Sprinkler Systems: Guardian Series 9500 floor control and test module to be installed on sprinkler systems exceeding 175 psi at the inlet side of the valve.

2.3 FIRE DEPARTMENT AND HOSE EQUIPMENT:

- A. Class I Fire Department Valve Cabinet: Potter-Roemer, Inc. Fig. 1830, 10" Deep, 20 gauge recessed painted steel box, 20 gauge tubular steel full glass door with 20 gauge frame, continuous steel hinge, and brass pin. Steel corner seams welded and ground smooth. Include Potter-Roemer, Inc. Fig. 4065 2-1/2" fire department valve rough brass finish with 2-1/2" x 1-1/2" reducer with cap and chain. Hose connection shall match responding fire department requirements.
- B. Fire Department Valve: Globe Valve, Potter-Roemer, Inc. Fig. 4115 2-1/2" rough brass with cap and chain. Hose connection shall match responding fire department requirements.
- C. Exposed Fire Department Connection: Potter-Roemer, Inc. Fig. 5751-D, polished chrome plated 4 x 2-1/2 x 2-1/2 cast brass two-way inlet body with drop clappers, pin lug swivels, plugs, and chains. Polished chrome plated cast brass wall plate with proper lettering.

- 2.4 FIRE HYDRANT: Mueller Super Centurion 200 A-423 “pumper” style three way hydrant. Furnished with 6” mechanical joint inlet. Working pressure 250 PSI, 500 test pressure compression type main valve. Provide bury length as site conditions require and allow hose connections to be placed at not less than 24” above finished grade and not more than 36” above finished grade.
- 2.5 DOUBLE CHECK DETECTOR ASSEMBLY: Shall consist of two (2) independently acting check valves, two (2) resilient seated outside stem and yoke gate valves and four (4) test cocks together with a by-pass that includes a water meter and reduced pressure backflow preventor. Valve bodies and cover shall be manufactured of ductile iron ASTM A536, Grade 65-45 12. Ductile iron bodies shall be flanged, ANSI B16.1, Class 125 epoxy coated. Assembly must be factory assembled and backflow tested. The assembly shall be constructed so all internal parts can be serviced from the top, side, or removed while assembly is in line. The assembly shall be rated 175 MWWP (32° - 140° F).
- 2.6 REDUCED PRESSURE ZONE ASSEMBLY: A Reduced Pressure Zone Assembly shall be installed at each cross-connection to prevent backsiphonage and backpressure of hazardous materials into the potable water supply. The assembly shall consist of a pressure differential relief valve located in a zone between two (2) positive seating cam-check assemblies. The main valve body shall be manufactured from 300 Series stainless steel for corrosion resistance. The cam-check assembly shall be of thermoplastic construction with stainless steel hinge pins, cam arm, and cam bearing. The cam-check assembly shall utilize a single torsion spring design to minimize pressure drop through the assembly. The cam-check assembly shall be modular and shall seal to the main valve body by the use of an O-ring. There shall be no brass or bronze parts used within the check assembly or relief valve. The use of seat screws to retain the check valve seat is prohibited. All internal parts shall be accessible through a single cover on the valve assembly securely held in place by a two-bolt grooved coupling. The differential relief valve shall be of stainless steel construction and shall utilize a rolling diaphragm and no sliding seals. The relief valve shall be bottom mounted and supplied with a steel reinforced sensing hose. The assembly shall include two (2) resilient seated shutoff valves and four (4) ball type test cocks. The assembly shall be an Ames Company Series 4000SS.
- 2.7 VALVE ENCLOSURE:
- A. As manufactured by Aqua Shield or equivalent.
 - B. Material for panels shall be 5032-H32 aluminum (0.050 / 18 gauge) and shall comply with ASTM B209. The aluminum shall have a standard mill finish.
 - C. Insulation shall be a closed cell polyisocyanurate foam core laminated to heavy, black glass fiber reinforced facers each side, the insulation shall have the following property’s:
 - 1) R-Value – 10

- 2) Dimension stability – 2 % linear change
- 3) Compressive strength – 20 PSI and 25 PSI
- 4) Product density – normal 2.0 PCF
- 5) Water absorption – <1 % by volume
- 6) Service temperature – -100° F to + 250° F
- 7) Moisture vapor transmission – <1 Perm
- 8) Flame spread – 25
- 9) Thickness – 1.5”

- D. Adhesive shall be Hilti brand product CA-3200.
- E. The exterior of the panels shall have a protective PVC masking to protect finish before assembly. The protective masking shall be removed before assembly of the enclosure.
- F. Access panels shall have factory installed locks with master keys provided.
- G. Heating equipment shall be designed and provided by the manufacturer to maintain a minimum internal temperature of 40° F with the external temperature of -34° F. There shall be one (1) 1000W / 120V / 1PH heater thermostatically controlled.
- H. Enclosure shall be assembled plumb and square on a concrete pad as per manufacturers provided instructions.

2.8 SWITCHES AND DEVICES:

- A. OS&Y Tamper Switches: Switches equivalent to System Sensor Model OS&Y 2. Two (2) sets of SPDT (form C) contacts; 10.0A @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- B. PIV Tamper Switches: Switches equivalent to System Sensor Model PIBV2. Two (2) sets of SPDT (form C) contacts; 10.0A @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- C. Flow Switches: Switches equivalent to System Sensor WFD series. Two (2) sets of SPDT (form C); 10.0A, 1/2 HP @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- D. Pressure Switches: Switches equivalent to System Sensor Model EPS10-2. Two (2) sets of SPDT (form C); 10.0A, 1/2 HP @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range -40 F to 160 F.

- E. Test and Drain: Test and drain equivalent to AGF Model 1000. UL / FM / ULC approved device, which shall be piped to suitable drainpipe.
- F. Riser Manifold: Riser manifold equivalent to Tyco Fire Products Fig. 513, 513D, 513R. Working pressure is 175 PSI equipped with; water flow switch, ball valve, test and drain, valve with properly sized test orifice, and sight glass. Provide optional pressure relief valve for grid system installation.

2.9 SPRINKLERS:

- A. All sprinklers for Light Hazard and all standard spray sprinklers for Ordinary Hazard shall be quick response.
- B. All sprinklers placed in finished ceilings shall be white finish with white recessed escutcheons, unless otherwise noted on the fire protection plans.
- C. All sprinklers shall be UL approved for the designed location and use.
- D. Temperature ratings of sprinklers based on distances from heat sources shall comply with the specific table in NFPA 13. It is NOT acceptable to provide higher “rated” sprinklers throughout a room, compartment, or area unless specifically required to do so by NFPA 13.
- E. Sprinkler head locations for 2’ x 4’ (or similar) acoustical tile lay in ceiling panel shall be designed to hit a place anywhere in the tile which is no closer than 9” to the tee bar. It is preferred that the sprinklers hit the quarter points of the tile however, in order to limit the sprinkler head count the above is acceptable. For 2’ x 2’ tiles sprinklers shall be no closer than 9” to the tee bar. It is preferred that the sprinklers hit the centerline of the tile however, in order to limit the sprinkler head count the above is acceptable. NOTE: This is a not a requirement for “return bends” to be installed to hit specific locations. This requirement is not in force for non-public small rooms such as toilets, janitor closets, storage rooms, kitchens or the like. In these rooms sprinklers shall be installed at no closer than 6” to ceiling tee bars.
- F. Sprinkler head locations for 2’ x 2’, and 2’ x 4’ (or similar) acoustical tile lay in ceiling panel shall be installed at the centerline of the tile. NOTE: This is a requirement for “return bends” to be installed to hit specific locations. See plan for areas or rooms which apply. This requirement is not in force for non-public small rooms such as toilets, janitor closets, storage rooms, kitchens or the like. In these rooms, sprinklers shall be installed at no closer than 6” to ceiling tee bars.
- G. Provide compatible sprinkler head guards for all pendent and upright sprinklers when the sprinkler deflector is installed below 7’ AFF.

2.10 HANGERS: All hangers shall be UL / FM approved.

- A. CPVC Pipe Hangers: Hangers shall be designed and installed as per the requirements of the manufacturer and NFPA. No hanger component shall be

allowed to come in contact with CPVC pipe unless that component is specifically listed for that contact.

- B. Contractor is cautioned to consider hanger locations when system pressure exceeds 100 PSI.
- C. Provide seismic bracing / restraints and the accompanying calculations as required by the building code in force. All seismic appurtenances shall comply with NFPA #13. Seismic bracing / restraints are required on this project.

PART 3 - EXECUTION

- 3.1 **INSTALLATION:** Install fire protection system in accordance to OSHA, NFPA, and local codes regulations and manufacturers recommendations. Refer to the drawings for a description of areas to be sprinklered and types of hazard. All fire protection piping shall be designed and installed after coordination with all other trades that may conflict with sprinkler routing. Coordinate location of sprinkler heads with Architect's reflected ceiling plan, lighting layout, and HVAC diffuser layout. In exterior vestibules, other outside entrance areas, and exterior type stairwells, install dry type sprinklers.
- 3.2 **FIRESTOPPING:** All pipe penetrations of rated partitions shall be properly caulked with fire caulking including sidewall sprinkler heads penetrating such partitions.
- 3.3 **SPARE PARTS / SIGNAGE:**
 - A. Provide and install all required signage on sprinkler system equipment, pipe, control valves, devices, and auxiliary drain valves as per NFPA #13.
 - B. Provide system tag at each system control valve. Each tag to be self-indicative of the area controlled by that valve.
 - C. Provide appropriate count sprinkler head cabinet with proportionate number of sprinklers and at least one sprinkler wrench for each type sprinkler installed on site. Locate the head cabinet as per owner's directive.
- 3.4 **CLEANUP:**
 - A. Special care shall be taken at all times but especially during "finish out" stage while using the pipe cutting / threading machine. Provide protection below power machine to prevent drips and spills of cutting oil.
 - B. All exposed finished surfaces shall be wiped clean of smudges, fingerprints, etc..
 - C. Sprinkler contractor is specifically responsible for removal of all debris created as a direct or indirect result of his portion of the construction project.

- 3.5 CLOSE OUT: Before application for final payment is requested the contractor is to provide all requirements set forth by the General Conditions of the Specifications and deliver to the engineer of record (Insight Engineering) the following:
- A. One (1) full set of "AS BUILT" drawings. Provide "DBX As Built Drawings" cabinet, size D, by Space Age Electronics. Field locate cabinet adjacent to fire riser.
 - B. One (1) full set of Operating and Maintenance Manuals.
 - C. One (1) full set of applicable and executed test certificates for each system.
 - D. One (1) full set of electronic files (.dwg format) containing all fire protection shop drawings used in the performance of the contract. These files shall match the "AS BUILT" drawings stated in Section A above.
 - E. On site training of owner specified personnel shall be coordinated through the General Contractor. Training session(s) shall be provided in order to familiarize the owner with the various operations of the systems installed. The sprinkler contractor shall direct and illustrate to the owner the function of the various sprinkler valves in his facility. The sprinkler contractor is to show the owner the location of all control valves and drain valves as well as illustrate these valves specifically. Upon completion of the training session the sprinkler contractor shall provide a letter to the owner for his signature containing the content of the training session. This letter shall be forwarded to the engineer of record (Insight Engineering).

END OF SECTION 15500

SECTION 15600 - HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE:

- A. Extent of heating, ventilating and air conditioning (herein after referred to as HVAC) equipment is indicated by drawings and schedules, and by requirements of this section.
- B. Types of equipment required for the project include, but is not limited to, the following:
 - 1) Unit Heaters
 - 2) Gas Fired Furnaces
 - 3) Split System Condensing Units
 - 4) Filters (30, 60, 90 and 99.97 % efficiency)
 - 5) Supply, Exhaust and Ventilation Fans

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS:

- A. Vibration isolation and flexible connectors for HVAC equipment; Section 15200.
- B. Insulation of HVAC equipment; Section 15250.
- C. Air distribution equipment, Boiler venting; Section 15800.
- D. Control work required in conjunction with HVAC equipment; Section 15900.
- E. Air and water side balancing; Section 15990.
- F. Motor starters, disconnects, power wiring of HVAC equipment and variable frequency drives; Division 16.

1.3 QUALITY ASSURANCE:

- A. AFBMA Standards: Load Ratings and Fatigue Life for Ball Bearings. Bearings must have an L10 life of not less than 200,000 hours for air handling units and utility vent sets, and an L50 life of not less than 200,000 hours for in-line and rooftop exhaust fans.
- B. AGA Standards: Boilers shall be tested, listed and certified in accordance with the requirements of the American Gas Association Laboratories and ANSI Standard Z31.13.

- C. AMCA Standards: Comply with Air Movement and Control Association (AMCA) standards as applicable to testing and rating fans (AMCA 300), air moving devices (AMCA 301) and testing of louvers, dampers and shutters.
- D. ANSI / ASHRAE Standards: Comply with ANSI / ASHRAE Standard 15 - Safety Code for Mechanical Refrigeration. Provide central station packaged air handling units which comply with ANSI Standard 430.
- E. ARI Certification: Provide central station packaged air handling units which comply with Air-Conditioning and Refrigeration Institute (ARI) Standard 410. Provide chillers which comply with ARI Standard 550.
- F. ARI / ASHRAE Standards: Heat Recovery Wheels shall be tested in accordance with the requirements of ASHRAE Standard 84 / ARI Standard 1060.
- G. ASHRAE Standards: Comply with ASHRAE Standard 52-76 as applicable to air filter efficiencies.
- H. ASME Code Compliance: Construct boilers in accordance with ASME Boiler and Pressure Vessel Code, "Heating Boilers", Section IV. Construct heat transfer units in accordance with ASME Boiler and Pressure Vessel Code, Section VIII "Unfired Pressure Vessels", bearing the National Board stamp.
- I. ASTM (& UL) Compliance: Thermal insulation for equipment shall have the following maximum UL Fire Resistance Ratings, per ASTM Standard E84, unless otherwise specified:
 - a) Flame Spread: 25
 - b) Fuel Contributed: 50
 - c) Smoke Developed: 0
- J. NEMA (& IEEE) Compliance: Provide electric motors which meet the scheduled full load efficiency, as indicated on the drawings, per NEMA Standard MG1-12.53a, based on dynamometer testing per IEEE 12 Method B.
- K. NEMA (& UL) Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories (UL) and comply with NEMA standards.
- L. NFPA Compliance: Comply with applicable provisions of ANSI / NFPA 70 "National Electric Code", pertaining to construction and installation of electrically operated components of packaged air handling units. Install fuel gas piping in accordance with NFPA 54 "National Fuel Gas Code".
- M. TEMA Standard Compliance: Construct and install heat transfer units in accordance with "Standards of the Tubular Exchanger Manufacturers Association".

- N. UL Compliance: Comply with UL Standard 900 as applicable to listing of air filters. Comply with UL 984 - Safety Standards for Hermetic Motor Compressors.
 - O. All electronic equipment shall conform to the requirements of FCC Regulations, Part 15, Section 15, governing radio frequency and electromagnetic interference and shall be so labeled.
- 1.4 SUBMITTALS: Comply with Sections 01300 and 15000.
- A. General: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated (including fan and pump curves, tabular data etc.), weights and loadings (shipping, installed, and operating where applicable), construction materials furnished (including gages and finishes), required clearances, location and size of field connections, motor electrical characteristics and accessories. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed. Indicate equipment, piping and connections, valves, strainers, piping accessories required for a complete system. Submit suggested structural steel support, including dimensions, sizes and locations for mounting bolt holes. Include weight distribution drawings showing point loadings.
 - B. Provide data as described above for the following equipment:
 - 1) Unit Heaters
 - 2) Gas Fired Furnaces
 - 3) Split System Condensing Units
 - 4) Filters (30, 60, 90 and 99.97 % efficiency)
 - 5) Supply, Exhaust and Ventilation Fans
 - C. Air handling units: Submit manufacturer's capacities and ratings for fan and coils. A scale drawing, indicating overall dimensions, not less than 1/4" = 1' 0" scale will be required for all substituted airhandlers.
 - D. Any substitutions of specified HVAC equipment to be installed in a mechanical room will require revised plan and elevation drawings of each mechanical room where substitutions occur, in a scale not less than 1/4" = 1' 0". Drawings shall indicate equipment sizes, clearances and elevations, of ALL equipment (substituted and non-substituted). Failure to furnish revised mechanical room drawings with the substituted equipment submittal will result in rejection of the submission and no additional contract time will be allowed for delay of this cause.
 - E. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, construction details, and field connection details.

- F. Wiring Diagrams: Submit ladder-type wiring diagrams for electrically operated accessories. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - G. Electric Motors: All equipment specified with premium efficiency motors shall include data sheets, with equipment submittals, on motors. Data sheets shall include manufacture / model number of motor including statement motor complies with NEMA standard MG1 part 31.40.4.2.
 - H. Maintenance Data: Submit maintenance data, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists for each equipment item, including "trouble - shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.
- 1.5 DELIVERY, STORAGE AND HANDLING:
- A. Deliver HVAC equipment with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers. Factory assemble entire unit, where practical. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
 - B. Store HVAC equipment in clean dry place and protect from weather and construction traffic. Handle HVAC equipment carefully to avoid damage to components, enclosures, and finish. Leave factory shipping covers in place until installation. Do not install damaged components; replace and return damaged components to equipment manufacturer.
 - C. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

PART 2 - PRODUCTS

2.1

PART 3 - EXECUTION

- 3.1 INSPECTION: Examine areas and conditions under which HVAC equipment shall be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION (GENERAL): Install HVAC equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to insure that equipment complies with requirements and serves intended purposes. Install HVAC equipment with recommended clearances provided for service and maintenance.

- 3.3 ELECTRICAL CONNECTIONS: Ensure that HVAC equipment and components are wired properly, with rotation in direction indicated and intended for proper performance. Furnish to Electrical Installer, manufacturer's wiring diagram and electrical requirements for installation of field-wiring required for equipment (including control panels); not work of this section.
- 3.4 FIELD QUALITY CONTROL: Upon completion of installation of HVAC equipment, and after motors have been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.
- 3.5 INSTALLATION OF UNIT HEATERS:
- A. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
 - B. Install remote thermostat.
 - C. Gas Fired Unit Heaters:
 - 1) Extend gas piping and connect to unit, provide gas shutoff valve, 1/8" NPT plugged test connection, tee, and dirt pocket. Locate piping so as to not interfere with service of unit. Extend gas piping runout, full size of gas train inlet, from tee to gas train connection, provide union with sufficient clearance for unit removal and service.
 - 2) Install type B flue, storm collar and gravity vent cap for all gas fired equipment.
 - D. INSTALLATION OF GAS FURNACES:
 - E. Coordinate with other work, including ductwork and piping, as necessary to interface installation of packaged equipment with other work.
 - F. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
 - G. Extend gas piping and connect to unit, provide gas shutoff valve, 1/8" NPT plugged test connection, tee, and dirt pocket. Locate piping so as to not interfere with service of unit. Extend gas piping runout, full size of gas train inlet, from tee to gas train connection, provide union with sufficient clearance for unit removal and service.
 - H. Install type B flue, storm collar and gravity vent cap for all gas fired equipment.
 - I. Seal off area around return air plenums / furnace support frame.

- J. Install remote thermostat *and three (3) speed fan switch.*
- K. *Install Kenall Model TG-2 clear inflexible, injection molded Herculex thermostat covers with vandal proof screws.*

3.6 INSTALLATION OF CONDENSING UNITS:

- A. Install condensing unit on concrete pad and secure unit to pad with anchor bolts.
- B. *Install condensing unit on framing system and secure unit to pad with approved anchor devices.*
- C. Install all necessary refrigerant piping, fittings valves, etc., to provide a complete installation as indicated and as specified.
- D. Install the control devices furnished by the manufacturer, but not specified to be factory mounted in accordance with the manufacturer's instructions, complete with control wiring.

3.7 INSTALLATION OF DIRECT EXPANSION COOLING COILS:

- A. Install direct expansion cooling coil and all necessary refrigerant piping, fittings valves, etc., to provide a complete installation as indicated and as specified.
- B. Connect humidity condensate drain and route condensate piping to floor drain or as otherwise indicated on the drawings. Trap shall be adequately sized to properly drain condensate.

C. INSTALLATION OF FILTERS:

- D. Comply with applicable portions of ANSI / NFPA 70, 90A and B, pertaining to installation of air filters.

3.8 INSTALLATION OF CENTRIFUGAL PUMPS:

- A. Install pumps in accordance with manufacturer's instructions. Remove all bracing and blocking devices installed for shipment.
- B. Install base mounted pumps on concrete base with anchor bolts fastened into floor slab. Base shall be a minimum 4" high or as required for access and or clearance of piping devices such as strainers, suction diffusers, etc.
- C. Level and shim the unit base and grout to the concrete pad. Shim the driver and realign the pump and driver. Correct axial, angular or parallel misalignment of the shafts. Connect properly aligned and independently supported piping. Recheck alignment.

- D. *Install pumps on concrete inertia pads or on concrete pads with anchor bolts poured in place as indicated on the drawings. Set and level pump, grout under pump base with non-shrink grout.*
- E. Provide piping; accessories; hangers, supports, and anchors; valves; meters and pressure gauges; vibration isolation; and equipment supports; as indicated on the drawings for complete installation.
- F. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.
- G. Verify that the piping system has been flushed, cleaned and filled. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition. After several days operation, remove the disposable start-up strainer in the suction diffuser.
- H. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

3.9 INSTALLATION OF FANS:

- A. Coordinate with other work, including ductwork, floor construction, roof, wall, ceiling, and electrical work as necessary to interface installation of air handling equipment with other work.
- B. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level. Install vibration isolation devices as furnished with the unit or specified in Section 15200.
- C. Install all accessories, shipped loose such as roof curbs, speed controls, motorized dampers, shutters, vibration isolators, etc.
- D. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, bearings lubricated, and fan has been test run under observation.
- E. Electrical: Furnish electrical field-wiring diagrams to Electrical Contractor for power wiring of fan motor and motorized damper.

3.10 EXTRA STOCK:

- A. Provide one (1) spare set of belts for each different size or type required for the air handling units and exhaust fans.
- B. Filters used during construction shall be replaced for testing and balancing. The airhandler shall be furnished with clean filters at acceptance of project. Spare filters shall be turned over to the Owner.

JONESBORO MUNICIPAL AIRPORT
MAINTENANCE HANGAR RECONSTRUCTION

FEBRUARY 2021
CONSTRUCTION SET

END OF SECTION 15600

SECTION 15800 AIR DISTRIBUTION

PART 1 – GENERAL

- 1.1 SCOPE: Provide air distribution, complete, including ductwork, grilles, dampers and ductwork accessories.
- A. Ductwork System:
- 1) Low Pressure Ductwork: Defined as ductwork subjected to velocities of 2000 fpm or less, and operating pressure of 2" w.g. or less, positive or negative.
- B. Ductwork Accessories: Manual control dampers, duct hardware, duct access doors, flexible connections, and miscellaneous components.
- C. Grilles and Registers
- 1.2 RELATED WORK:
- A. Refer to Section 15250 for external insulation required in conjunction with ductwork; not work of this section.
- B. Refer to Section 15990 for balancing of air distribution devices; not work of this section.
- 1.3 QUALITY ASSURANCE:
- A. Installer: A firm with at least five (5) years of successful installation experience on projects with ductwork systems work similar to this project.
- B. Standards: Comply with SMACNA Duct Construction Standards (Low Pressure) - latest editions as of date of issue of these specifications.
- C. UL Compliance: Furnish labeled fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".
- D. NFPA Compliance: Comply with the latest editions of ANSI / NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI / NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
- 1.4 SUBMITTALS: Comply with Section 15000.
- A. Product Data:
- 1) Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork, used for work of this section.
 - 2) Submit manufacturer's air treatment equipment specifications and installation instructions including, but not limited to, dimensions, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, and fire classification.
 - 3) Submit manufacturer's data on diffusers and grilles, including the following:
 - a) Schedule of diffusers and grilles indicating drawing designation, room location, number furnished, model number, size and accessories furnished.
 - b) Data sheet for each type of diffuser and grille, and accessory furnished; indicating construction, finish and mounting details.

- c) Performance data for each type of diffuser and grille furnished, including airflow capacity, throw and drop, and noise criteria ratings. Indicate selections on data.
 - 4) Submit manufacturer's specifications for each type of duct accessory, including dimensions, capacities, and materials of construction; and installation instructions.
 - B. Shop Drawings: Submit dimensioned layouts of ductwork where required in the plans and specifications showing both the accurately scaled ductwork and its relation to space enclosure. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.
 - C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory, include this data in Maintenance Manual.
- 1.5 DELIVERY, STORAGE AND HANDLING:
- A. Protect fabricated ductwork, accessories and associated products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
 - B. Deliver diffusers and grilles wrapped in factory-fabricated fiberboard containers. Identify on outside of container, type of diffuser or grille and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- 1.6 Where possible, store air distribution and treatment products inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 – PRODUCTS

2.1 DUCTWORK MATERIALS:

- A. Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI / ASTM A 527, lockforming quality, with ANSI / ASTM A 526, G 90 zinc coating; mill phosphatized for exposed locations. Galvanized sheet steel shall be equal to Armco, Toncan or Youngstown.

2.2 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Furnish and install miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size necessary to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Low Pressure Duct Sealant: Furnish and install non-hardening, non-migrating mastic equal to "Hardcast" FTA-20 with DT tape.
- C. Ductwork Support Materials (Galvanized): Furnish and install hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- D. Aluminum Foil Tape: Furnish and install 3" width (minimum) aluminum tape equal to Hardcast "Foil Grip". Tape shall have 15 mils of elastomeric modified butyl adhesive on 2 mil foil backing. Tape shall comply with UL 181B-FX.

2.3 LOW PRESSURE DUCTWORK FABRICATION:

- A. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "Duct Construction Standards" (Low Pressure) latest edition, and as indicated on drawings.
- B. Furnish and install shop fabricated ductwork in 4,8,10 or 12 foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to the greatest extent possible, so as to minimize field assembly of systems. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
- C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
- D. Flexible Air Duct (Low Pressure): Furnish and install pre-insulated flexible air duct on air duct systems as shown on drawings. Duct shall be Technaflex Type MKE or approved equal. Duct shall be listed and labeled by Underwriters Laboratories, Inc. as a Class 1 air duct, Standard 181. Duct shall comply with NFPA 90A and 90B. Duct shall be rated for six inches w.c. positive pressure and 1" w.c. negative pressure and shall be rated for 4000 fpm. Duct shall consist of galvanized wire helix permanently bonded and enclosed in a polyester film and then covered with 1-1/2" thick, 3/4 pcf density fiberglass insulation sheathed in a vapor barrier of aluminum metalized polyester film laminated to glass mesh elastomer backed coated barrier. Vinyl or non-aluminized barriers will NOT be allowed. Maximum runout shall not exceed 8 ft. Minimum run out length shall not be less than 5 ft. Insulated flexible duct work shall be factory labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

2.4 DUCTWORK ACCESSORIES:

- A. Duct Hardware:
 - 1) Manual Damper Operator:
 - a) Accessible Ceilings: Furnish and install for each damper, splitter vane, or extractor, a quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
 - b) Inaccessible Ceilings: Provide a field fabricated bracket, miter gear operator equal to Young No. 914, couplings, shafts, and damper regulator (equal to Young No. 1) for each designated damper. Refer to the drawings.
 - 2) Where damper or splitter control rods extend through finished walls or ceiling, Contractor shall terminate rods in approved access box equal to a Young No. 1 surface mounted quadrant regulator.
 - 3) All splitter rods shall be provided with Young No. 656 - 3/8" or 659 - 1/2" end bearings using two (2) bearings per splitter damper.
- B. Flexible Connections: Furnish and install 30 oz. woven glass fabric, double coated with Neoprene "Ventglas", or equal, flexible connections to give no less than 3" clear break between metals joined, where indicated or required.

C. Branch Fittings: Provide take off fittings manufactured with airtight seams using a locking double seam. Units shall be constructed of 26 gage galvanized steel (minimum). Units shall have a factory installed volume damper with locking spring loaded quadrant. Damper regulator shall be elevated 2" to allow for insulation thickness. Fitting shall be conical type as described on the plans with a base mounting flange secured by a minimum of four sheet metal screws or pop-rivets. See drawings for alternate "Streamline" branch take-off fittings.

D. Manual Balancing Damper:

- 1) Low Velocity (Under 12" High): Furnish and install low velocity manual dampers equal to United Air Model EGS. Damper shall have 2" x 14 gage galvanized steel frame, 18 gage galvanized steel blade, 1/4" square plated steel control shaft and plated locking hand operator quadrant.
- 2) Low Velocity: Furnish and install low velocity manual dampers equal to American Warming and Ventilating Model VC-15 Opposed Blade Damper. Frames shall be 3-1/2" x 1" x 16 gage galvanized steel hat channels. Blades shall be 16 gage galvanized steel with 7-1/4" width. Axles shall be 1/2" diameter galvanized steel stub. Bearings shall be heavy duty molded self-lubricating nylon.

2.5 GRILLES AND REGISTERS:

A. General:

- 1) Furnish and install manufacturer's standard diffusers and grilles where shown or required. Diffusers and grilles shall be of size, shape, capacity and type indicated, and constructed of materials and components as indicated, as required for complete installation.
- 2) Performance: Provide diffusers and grilles that have, as minimum, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

2.6 Air distribution devices have been specifically selected based on Titus's performance data. If devices are submitted, other than those specified, the submittal must include an item by item selection of substitutions listed by space location. The list must include model number, size, air pattern, airflow, pressure drop, throw, NC noise level, finish and mounting method for both the submitted and specified device. Where compliance with performance requires different dimensions, such as neck or face size, than the specified item, the submittal must note where these dimension changes occur listing both the original and new dimensions.

PART 3 – EXECUTION

3.1 DUCTWORK FABRICATION:

A. General:

- 1) Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, air terminals, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions,

which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

- 2) Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
- 3) Install duct hangers and supports in accordance with SMACNA Standards, Section IV.

B. Sheet Metal (Low Pressure):

- 1) Sheet metal shall be fabricated reasonably air tight and light proof and shall be free of vibration and sag. Pittsburgh Lock Machine, if used, shall be kept in first class working order with rollers properly maintained so that no excessive peeling off of galvanized coating on metal will occur.
- 2) Sheet metal gages, reinforcing joints, seams, etc., shall be as called for in the latest edition of Sheet Metal and Air Conditioning Contractors National Associates, Inc., (SMACNA) "Duct Construction Standards" (Low Pressure).
- 3) Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.
- 4) All elbows shall have a throat radius equal to the width of the duct wherever possible. Turning vanes shall be installed in all square elbows. Horizontal ducts over 400 square inches in cross-sectional area shall be supported from overhead structure members by $\frac{3}{4}$ " x $\frac{1}{8}$ " strap iron. Horizontal ducts under 400 square inches in cross-sectional area shall be supported from overhead structure with the use of 1" wide 18-gage galvanized metal straps.
- 5) Seal all joints in rectangular supply, return, exhaust and outside air ductwork with "Hardcast" Type DT sealing tape and Type FTA adhesive, installed in strict accordance with manufacturer's instructions. Clean all dirt, oil, moisture, etc., from surfaces before applying adhesive.
- 6) Low pressure round ductwork shall be constructed and installed where shown on the plans. Ducts shall be constructed as called for in the latest edition of SMACNA "Duct Construction Standards" (Low Pressure). Longitudinal seams shall be Acme lock grooved seam type and joints shall be crimp and bead type. In lieu of crimp and bead joints, cement all seams, join with sheet metal screws and wrap duct tape over screws and cement.
- 7) Joining and Attaching Flexible Duct:
 - a) Collars to which flexible duct is attached shall be a minimum of 2" in length. Sleeves used for joining two sections of flexible duct shall be a minimum of 4" in length.
 - b) Collars and sleeves shall be inserted into flexible duct a minimum of 1" before fastening.
 - c) Non metallic flexible duct shall be secured to the sleeve or collar with a draw band. If the duct collar exceeds 12" in diameter the draw band must be

positioned behind a bead on the metal collar. One complete wrap of 3" wide aluminum tape shall be applied over draw band.

- d) Insulation and vapor barriers on factory fabricated flexible ducts shall be fitted over the core connection and shall also be secured with a draw band. One complete wrap of 3" wide aluminum tape equal to Hardcast "Foil Grip" shall be applied over draw band and at the connection between the insulation of the flexible duct and the insulation of the metal duct.
 - e) All flex duct connections shall be installed to ADC Standards and sealed to UL 181 standards per AMC 603 and 604.2.1
- 8) Supporting Flexible Duct:
- a) Flexible ducts shall be supported at the manufacturer's recommended intervals but at least every 10'. Maximum permissible sag shall be 1/2 inch per foot of spacing between supports. A connection to another duct or to equipment shall be considered a support point. Hangers shall be adequately attached to the building structure.
 - b) Hanger or saddle material in contact with the flexible duct shall be wide enough so that it does not reduce the internal diameter of the duct when the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1-1/2" wide. Narrower hanger material may be used in conjunction with a sheet metal saddle that meets this specification. This saddle must cover one-half the circumference of the outside diameter of the flexible duct and fit neatly around the lower half of the duct's outer circumference.
 - c) To avoid tearing the vapor barrier, do not support the entire weight of the flexible duct on any one hanger during installation. Avoid contacting the flexible duct with sharp edges of the hanger material. Damage to the vapor barrier may be repaired with 3" wide aluminum tape equal to Hardcast "Foil Grip". If the internal core is penetrated, replace the flexible duct.

3.2 CLEANING AND PROTECTION:

A. Ductwork:

- 1) Clean ductwork internally, section by section as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- 2) Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION 15800

SECTION 15990 TESTING ADJUSTING AND BALANCING

PART 1 – GENERAL

1.1 SCOPE:

A. Extent of Work:

- 1) Extent of testing, adjusting, and balancing work is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to: air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work.
- 2) The work consists of setting speed and volume (flow), adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by contract documents.
- 3) The total work required to complete this section of the specifications is to remain the responsibility of the Contractor.

B. Component types of testing, adjusting, and balancing specified in this section includes fans, ductwork systems (including supply, return and exhaust diffusers and grilles), *lab hoods* and piping systems.

1.2 QUALITY ASSURANCE:

A. TAB Credentials: The firm shall have at least five (5) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project. The individual mechanic assigned to this project TAB shall at least five (5) years of TAB experience.

B. Industry Standards: Comply with American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), National Environmental Balancing Bureau (NEBB) or Associated Air Balance Councils (AABC) recommendations pertaining to measurements, instruments, as well as testing, adjusting, and balancing.

C. The test and balance work shall be performed under the mechanical subcontract by an independent NEBB or AABC member contractor. Final reports shall be prepared by the test and balance subcontractor and submitted to the Owner through the mechanical subcontractor.

1.3 SUBMITTALS: Comply with Sections 01300 and 15000.

A. Submit certified test reports signed by Test and Balance Supervisor who performed TAB work. Include identification and types of instruments used and their most recent calibration data with submission of final test report.

B. Maintenance Data: Include in maintenance manuals, copies of certified test reports.

1.4 JOB CONDITIONS:

A. Do not proceed with testing, adjusting, and balancing work unit Work has been completed and is operable. Ensure that there is no latent residual work still to be completed.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

PART 2 – PRODUCTS

- 2.1 PATCHING MATERIALS: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings. Do not leave test holes uncovered.

PART 3 – EXECUTION

3.1 INSPECTION:

- A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.
- B. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- C. Examine equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- D. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1) Permanent electrical power wiring is complete.
 - 2) Equipment and duct access doors are securely closed.
 - 3) Balance dampers are open.
 - 4) Isolating and balancing valves are open and control valves are operational.
 - 5) Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6) Windows and doors can be closed so design conditions for system operations can be met.
- G. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

- 3.2 TESTING, ADJUSTING, AND BALANCING: Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as follows:
- A. Balance the air system(s) in the following manner:
 - 1) Test and adjust blower speed or vane setting to design requirements within +/- 5 % of design requirements).
 - 2) Test and record motor full load amperes.
 - 3) Make pitot tube traverse of main supply ducts and obtain design cfm at fans.
 - 4) Test and record system static pressures, suction and discharge.
 - 5) Test and adjust system for design cfm recirculated air.
 - 6) Test and adjust system for design cfm outside air.
 - 7) Test and record entering air temperatures of heating and cooling coils (both db and wb of cooling coils).
 - 8) Test and record leaving air temperatures of heating and cooling coils (both db and wb of cooling coils).
 - 9) Adjust all main supply and return air ducts to proper design cfm.
 - 10) Test and adjust each diffuser, grille and register to within +/-10 % of design requirements. Use proportional method of balancing. All outlets shall be reread after final adjustment.
 - 11) Each grille, diffuser, and register shall be identified to location and area on set of drawings.
 - 12) Size, type and manufacturer of diffusers, grilles, registers, and tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
 - 13) Readings and tests of diffusers, grilles and registers shall include required fpm velocity and test resultant velocity, required cfm and test resultant cfm after adjustments.
 - 14) In cooperation with the control manufacturer's representative setting adjustments of automatically operated dampers to operate as specified, indicated and / or noted.
 - B. Prepare reports of test results, including instrumentation calibration reports, in format recommended by applicable standards.
 - C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 - D. Mark equipment settings, including damper control positions, valve indicators, manual fan speed controllers and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

- E. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- F. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15990

SECTION 16010 BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES:

- A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 General Requirements

- 1.2 DRAWINGS: The Electrical Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the existing work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. Because of the small scale of the Electrical Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, and accessories as may be required to meet such conditions.

1.3 REFERENCES:

- A. The latest applicable edition of specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:

- 1) National Electrical Code
- 2) National Fire Protection Association's Recommended Practices
- 3) Local, City & State Codes & Ordinances
- 4) National Electrical Safety Code
- 5) Underwriter's Laboratories, Inc.
- 6) Illumination Engineering Society
- 7) Institute of Electrical & Electronic Engineers
- 8) Insulated Power Cable Engineers Association
- 9) National Electrical Manufacturers Association
- 10) Earthquake Requirement of the International Building Code
- 11) American Society for Testing Materials
- 12) Occupational Safety & Health Act
- 13) Service requirements of serving utility company
- 14) Americans with Disabilities Act (ADA)
- 15) ASHRAE / IESNA Standard 90.1

1.4 SUBMITTALS:

- A. Submit product data grouped to include complete submittals of related systems, products, and accessories in a single submittal using manufacturer's cutsheets. The basic information for each item of equipment to be included is as follows:

- 1) Index of submitted items
- 2) Installation and operation Instructions

- a) Manufacturer descriptive literature
- b) Wiring diagrams if any
- 3) Each submittal sheet shall be clearly marked with equipment Catalog Number and accessory items being submitted highlighted as necessary on sheets with multiple catalog numbers.

1.5 REGULATORY REQUIREMENTS:

- A. Work shall conform to all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor, in such cases, may at his option propose any article, approved equal to or better than that specified, as approved in writing by the Architect.
- C. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- D. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the contract documents, the most stringent shall govern. The contractor shall promptly notify the Architect in writing of any such difference.
- E. Non-Compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.
- F. All required fees, permits and inspections shall be obtained and paid for by the contractor under the section of the specifications for which they are required.

1.6 UTILITY FEES AND REQUIREMENTS:

- A. This Contractor shall be responsible for all costs incurred by the serving utilities for the relocation, removal, and installation of new services.
- B. The Contractor shall be responsible for coordinating and providing the exact service equipment and installation methods with the serving Utility prior to bidding. Failure to do so will not constitute sufficient grounds for an authorized change order to the project.

1.7 PROJECT / SITE CONDITIONS:

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Architect / Owner reserves the right to relocate any device a maximum distance of 6' - 0" at the time of installation without an extra cost being incurred.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect / Engineer before proceeding.

1.8 CONTRACTOR REVISED DRAWINGS:

- A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of

changes may be kept by accurately making all changes on a set of prints during the progress of the job.

- B. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Architect, one set of "contractor revised" reproducibles, legibly and accurately marked to indicate all changes and additions.
- C. This Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.9 SHOP DRAWINGS:

- 1.10 The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
- 1.11 The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.
- 1.12 Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
- 1.13 All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
- 1.14 The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
- 1.15 The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
- 1.16 INSTRUCTIONS OF OWNER'S REPRESENTATIVE: The Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical and electrical systems. A competent representative of the Contractor

shall spend sufficient time in such formal instruction to fully prepare the Owner to operate and maintain the Electrical Systems.

1.17 OPERATING AND MAINTENANCE MANUALS:

- A. After approval of materials and equipment for use in this project, a copy of an Operation and Maintenance Manual shall be submitted for approval.
- B. The basic information for each item of equipment to be included is as follows:
- C. Index
- D. Maintenance and operating instructions
- E. Manufacturer's descriptive literature and maintenance manuals
- F. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Architect and hold two (2) copies for instruction of Owner as hereinafter specified.

1.18 GUARANTEE:

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.
- B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Architect, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of one (1) year.
- C. WARRANTY: The Contractor shall, after completion of the original test of the installation, and acceptance by the Architect, provide any service incidental to the proper performance of the plumbing, air conditioning, ventilating, heating and control systems under guarantees outlined above for a period of one (1) full year after acceptance by the Architect and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for one (1) full year after final acceptance by the Architect.

1.19 DEFINITIONS:

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

1.20 ELECTRICAL LICENSE REQUIREMENT:

- A. No person shall perform electrical work on the contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS:

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. When two (2) or more units of materials or equipment of the same type or class are required, these units shall be products of one (1) manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- D. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
- F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.
- G. It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.
- H. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

2.2 EQUIPMENT ACCESSORIES:

- A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.
- B. Connections: All final connections to equipment shall be installed as required by the manufacturer and / or Vendor.
- C. Connections Different from Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes. The Contractor shall provide any

additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

PART 3 – EXECUTION

3.1 COORDINATION OF WORK:

- A. The Contractor shall compare the Electrical Drawings and Specifications with the drawings and specifications for other trades including that of the Utility and shall report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the Electrical Work. The Electrical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the Electrical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of conduits and electrical equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each conduit and equipment gear prior to installation.
 - 1) Right-of-Way: General and structural components have right of way. Equipment and piping whose elevations cannot be changed shall have the right of way over equipment and piping whose elevations can be changed. The Contractor shall coordinate the location of all electrical gear and piping with all trades prior to installation.
 - 2) Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.

- E. Installation and Arrangement: The Contractor shall install all Electrical Equipment to permit removal (without damage to other parts). Provide adequate access to all other parts requiring periodic replacement or maintenance. The Contractor shall arrange equipment to permit ready access to components and to clear the openings of swinging and overhead doors and of access panels.

3.2 REMOVAL OF RUBBISH:

- A. Contractor shall remove his rubbish from building site at intervals and shall maintain the spaces allotted him in an orderly manner. On completing his work, and prior to submission of final estimate, he shall remove all tools, appliances, material and rubbish from the grounds.

3.3 ROTATIONAL TESTS:

- A. The Contractor shall perform rotational tests on all motors provided under this contract. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.

3.4 CUTTING AND PATCHING:

- A. Under each Section of the specifications, the Contractor shall be responsible for all required digging, cutting, etc., incident to his work under that Section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.
- B. Pavements, sidewalks, roads and curbs shall be cut, patched, repaired and / or replaced as required to permit the installation of the work of the various trades and such cutting, patching, repairing and replacing shall be the responsibility of and paid for by the Contractor under the Section of the specifications for the trade requiring the work.
- C. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades required because of his fault, error or tardiness or because of any damage done by him.

3.5 EXCAVATION AND TRENCHING FOR ELECTRICAL CONDUIT:

- A. Trench Excavation and Backfill: By Utility
- B. Depth of Cover: By Utility
- C. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

3.6 CONSTRUCTION PHASING:

- A. The Contractor shall refer to the General Requirements of this specification and prepare all work schedules required to perform all work as shown on the Drawings and as herein specified.
- B. All services shall be maintained to all areas of the building during this Contract. Temporary service connections will be required where necessary to maintain these

- services. The Contractor will make these connections as required to provide continuous service.
- C. It will be the responsibility of the Contractor to carefully review the drawings, specifications and existing conditions with reference to these types of services so that the building may function normally during the construction process.
 - D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
 - E. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

END OF SECTION 16010

SECTION 16055 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical identification specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical identification is indicated by drawings and schedule.
- B. Types of electrical identification specified in this section include the following:
 - 1. Cable conductor identification (not including low voltage)
 - 2. Danger signs
 - 3. Equipment/system identification signs
- C. Refer to electrical general provisions sections for equipment system nameplates and performance data.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with not less than 5 years of successful experience in installation of raceways similar to those required for this product.
- C. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each identification material and device required. Include data substantiating that materials comply with requirements.
- B. Sample: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufactures offering identification products which may be incorporated in the work include, but are not limited to, the following:
1. Almetek Industries, Inc.
 2. Brady Co.
 3. Cole-Flex Corp.
 4. Griffolyn Company
 5. Ideal Industries, Inc.
 6. LEM Products, Inc.
 7. National Band and Tag Co.
 8. Radar Engineers Div.; EPIC Corp.
 9. Seton Name Plate Co.
 10. Tesa Corp.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Engraved Plastic-Laminate Signs:
1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness' indicated, engraved with engraver's standard letter style of sizes and wording indicated, black and white core (letter color) except as otherwise indicated, punched for mechanical fastening.
 - a. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
 - b. Fasteners: Self-tapping stainless steel screws.

2.3 LETTERING AND GRAPHICS

- A. Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or as required for proper identification and operation/maintenance of electrical systems and

equipment. Specific wording shall be approved by the Engineer.

PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Coordination: Where identification is to be applied to surfaces which requires finish, install identification after completion of painting.
2. Regulations: Comply with governing regulations and requirements or authorities having jurisdiction for identification of electrical work.

B. Operational Identification and Warnings:

1. Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

C. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
 - a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110 - 120 volts.
 - b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

D. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide double line of text, 3/8" high lettering on 1 - 1/2" high sign, white lettering in black field for items fed from normal power circuits. Provide text matching terminology and numbering of the

contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

- a. Panel boards, electrical cabinets and enclosures
- b. Electrical switchgear
- c. Motor control centers
- d. Power transfer equipment
- e. Transformers
- f. Starters
- g. Disconnects
- h. Junction boxes larger than 8" x 8"
- i. Circuit breaker enclosures
- j. Power generating units

2. The following are sample:

Panel	Panel XXX	XXX AMPS
xxx/xxx Volts	X Phase	X Wire
Equipment	(Equipment Name)	
Panel XXX	Circuit XX	
Disconnect	(Equipment Name)	
Panel XXX	Circuit XX	

- 3. Signs for equipment on emergency power shall be white with red letters, and signs for equipment on normal power shall be black with white letters.
- 4. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners.
- 5. Signs located at the following items shall have text which will provide manufacturing date and serial number:
 - a. Service entrance equipment
 - b. Transformers (greater than 45 KVA)

- c. Switchgear and switchboards
- d. Standby generators
- e. Transfer switches
- f. Motor control centers

END OF SECTION 16055

SECTION 16070 ELECTRICAL CONNECTIONS FOR EQUIPMENT
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section and is part of each Division 16 section referring to electrical connections specified herein.
- C. See Division 16 Section 16110 for conduit and Division 16 Section 16112 for surface mounted raceway.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include, but not necessarily limited to, connections for providing electrical power to equipment.
- B. Types of electrical power connections specified in this section include the following:
 - 1) Distribution system
 - 2) Branch circuits
 - 3) Grounding
 - 4) Circuit Breakers
 - 5) Panelboards
 - 6) To ground
- C. Junction boxes and other electrical units of equipment are specified in applicable Division 16 sections.
- D. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturing of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical connection work similar to that required for project.

- C. NEC Compliance: Comply with applicable portions of NEC as to type projects used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.
- D. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to electrical connections for equipment.
- E. ANSI Compliance: Comply with applicable ANSI standards pertaining to products and installation of electrical connections.
- F. Labels: Provide electrical connection products and materials, which have been listed or labeled by a nationally recognized testing laboratory engaged in the testing, listing and labeling of electrical materials and equipment.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of product):
 - 1) Appleton Electric Co.
 - 2) Arrow-hart Div., Crouse-Hinds Co.
 - 3) Burndy Corp.
 - 4) Ideal Industries, Inc.
 - 5) T and B/Thomas and Betts Corp.

2.2 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices and termination of types indicated.
- B. Metal Conduit, Tubing and Fittings:
 - 1) General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements; comply with NEC Division 16 basic materials and methods sections “Raceways”, and in accordance with the following listing of metal conduit, tubing and fittings.
 - a) Galvanized Rigid steel conduit

- b) Rigid metal conduit fittings
 - c) Electric metallic tubing
 - d) EMT Fittings
- C. Wire, Cable and Connectors:
- 1) General: Provide wires, cables and connectors complying with Division 16 basic materials and methods section "Wires and Cables".
 - 2) Wire: Unless otherwise indicated, provide wires/conductors for electrical connections, which match wires/conductors of wire supplying power.
- D. Electrical Connection Accessories:
- 1) Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wire nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTION

- A. Install electrical connections as indicated; in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- C. Coordinate installation of all required electrical connections for equipment with equipment supplier.
- D. Cover splices with electrical insulation equivalent to, or of higher rating, than insulation on conductors being spliced.
- E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated.
- F. Trim cables and wires, as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- G. Tighten wire-binding connector screws firmly.

- H. Terminals for Designed Use: Each cable, conductor or wire shall terminate in a lug designed for that particular use: (i.e., one conductor per lug unless lug is designed to have additional conductors installed).
- I. Check and re-tighten all splices, joints, terminations and connections originally installed by the manufacturer, where bolted, threaded or other mechanical means were used to secure joints and splices.

END OF SECTION 16070

SECTION 16110 - RACEWAYS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical raceways specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the following:
 - 1. Electrical metallic tubing
 - 2. Flexible metal conduit
 - 3. Liquid-tight flexible metal conduit
 - 4. Rigid metal conduit
 - 5. Non-metallic conduit

1.3 QUALITY ASSURANCE

- A. Installer: A firm or individual with not less than 5 years of successful experience in installation of raceways similar to those required for this project.
- B. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to raceways.
- C. UL Compliance with Labeling: Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components, which have been UL-listed and labeled.
- D. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of raceway systems.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness') for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill Wiring

requirements, and comply with applicable portions of NEC for raceways.

- B. Rigid Steel Conduit: FS WW-C-0581 and ANSI C80.1
 - 1. Minimum size shall be 3/4 inch
- C. Rigid Metal Conduit Fittings: FS W-F-408
 - 1. Use Type 1 fittings for raintight connections
 - 2. Use Type 2 fittings for concrete tight connections
 - 3. Use Type 3 fittings for other miscellaneous connections
- D. Electrical Metallic Tubing (EMT): FS WW-C-563 and ANSI C80.3
 - 1. Minimum size shall be 3/4 inch
- E. EMT Fittings: FS W-F-408
 - 1. Use Type 1 fittings for raintight connections
 - 2. Use Type 2 fittings for concrete tight connections
 - 3. Use Type 3 fittings for other miscellaneous connections
- F. Flexible Metal Conduit: FS WW-C-566, of the following type:
 - 1. Minimum size shall be 1/2 inch
 - 2. Type 2: Zinc-coated steel
- G. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, and Style A
- H. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible and continuous, interlocked, and double-wrapped steel; galvanize inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).
 - 1. Minimum size shall be 3/4 inch
- I. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G
- J. Non Metallic Conduit: Schedule 80 PVC
 - 1. Minimum size shall be 1 inch
 - 2. NEMA TC 2 Pipe
 - 3. NEMA TC 3 Fittings

4. Manufacturers:
 - a. Carlon
 - b. Engineer Approved

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.
 1. The use of ceiling support wires or tie wires is not acceptable as support or fastening for raceways or conduit.
- B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- C. Level and square raceway runs, and install at proper elevations and/or heights. Conduit shall be run parallel and perpendicular to the building construction.
 1. All conduit shall be installed above other trades (ductwork, piping, etc.) and supported to the structure.
 2. In corridors, the conduit should be installed to one or each side (either high on the wall or at structure) for accessibility.
- D. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- E. Install flexible conduit for motor connections, final connections to light fixtures, and for other electrical equipment connections where subject to movement or vibration.
- F. Install liquid-tight flexible conduit for connection of motors and for other electrical equipment in all central plants, boiler rooms, and where subject to movement and vibration (six foot maximum length), and also where subjected to one or more of the following conditions:
 1. Exterior location
 2. Moist or humid atmosphere where condensate can be expected to accumulate
 3. Corrosive atmosphere
 4. Subjected to water spray
 5. Subjected to dripping oil, grease, or water
 6. Wherever possible, install horizontal raceway runs above water and steam

pipng

- G. All interior concealed conduit shall be EMT with die cast compression fittings. Use flexible metal conduit at final fixture and equipment connections only, not longer than six feet.
 - 1. Use of rigid nonmetallic and flexible nonmetallic conduit in any interior applications is unacceptable.
 - 2. Final connections to lay-in light fixtures shall be made with a 6 foot length of flexible conduit from a junction box to the fixture. Flexible conduit connections from fixture to fixture will not be acceptable.
- H. For interior exposed locations such as Storage, Mechanical, and similar rooms the following shall apply:
 - 1. Lighting and power circuits below 10' - 0" AFF: all conduit shall be galvanized rigid steel (GRSC).
 - 2. Lighting and power circuits above 10' - 0" AFF: conduit is permitted to be electrical metallic tubing (EMT).
 - 3. Communications (telephone, computer, EMCS, and similar) systems conduit is permitted to be EMT.
- I. For interior exposed conduit locations such as Electrical Rooms and Communications Closets the following apply:
 - 1. Lighting and power circuits shall be GRSC or EMT.
 - 2. Communications systems conduit shall be GRSC or EMT.
- J. All concealed or exposed panel feeders and three phase motor branch circuits shall be GRSC.
- K. For exterior exposed conduit locations on Cooling Towers conduit shall be GRSC with minimum 40 mil PVC coating or equivalent. All conduit installed below grade shall be rigid steel or Schedule 80 PVC with rigid steel elbows.
- L. All conduit installed below grade shall be rigid steel or Schedule 80 PVC with rigid steel elbows.
- M. Arrange supports to prevent misalignment during wiring installation.
- N. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Supports shall be installed within 3 feet of every outlet box, junction box, panel, fitting, etc. Do not space supports further than 10 feet apart.
- O. Group related conduits; support using conduit rack. Construct rack using steel channel.

- P. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.
- Q. Arrange conduit to maintain headroom and present neat appearance.
- R. Install insulated bushings on each end of power conduit 1-1/4 inch and larger and on all auxiliary systems conduit.
- S. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 F. Wherever possible, install horizontal raceway runs above water and steam piping.
- T. Cut conduit square using saw or pipecutter; de-burr cut ends.
- U. Bring conduit to shoulder of fittings; fasten securely.
- V. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- W. Install no more than equivalent of three 90-degree bends between boxes. Use factory elbows for all 90 degree bends for conduits 1-1/4" or larger.
- X. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Y. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- Z. Provide suitable pull string in each empty conduit except sleeves and nipples.
- AA. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.
- AB. Ground and bond conduit under provisions of Section 16452.
- AC. Identify conduit under provisions of Section 16055.
- AD. Provide suitable pullboxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.

3.2 COORDINATION WITH OTHER TRADES

- A. All conduit shall be installed as high as possible being supported directly to bottom of structure to avoid conflicts with ductwork and piping. In corridors, conduit shall be mounted to the sides of the corridor either on the wall up high or to the structure. The electrical contractor shall coordinate installation with the mechanical contractor.

3.3 ADJUSTING AND CLEANING

- A. During installation of raceways, inspect interiors of raceways; remove burrs, dirt, and construction debris.

- B. Upon completion of installation of raceways and before conductor installation, inspect interior of raceways and swab out dirt and construction debris.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve all partition ratings to include, but not be limited to, fire, sound, and HVAC (plenum).
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- C. Pullboxes shall be provided at points shown on the plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction.
- D. All threaded conduit shall be secured to boxes, cabinets, panels, etc. by means of a threaded bushing on the inside and locknuted on the box exterior and interior.

3.5 PROHIBITED USES

- A. EMT set-screw fittings.
- B. Spray (aerosol) PVC cement.
- C. All thread nipples in other than dry locations.
- D. Wooden plugs inserted in concrete or masonry units as bases for fastening conduits, tubing, boxes, cabinets, or other equipment.
- E. Installation of conduit or tubing, which has been crushed or deformed.
- F. Torches for bending PVC conduit.
- G. LB Fittings. All bends for conduits 1-1/4" or larger shall be factory made 90 degree elbows.
- H. Wire nuts shall not be used for splicing control wiring.

END OF SECTION 16110

SECTION 16120 - WIRES AND CABLES

PART 1 GENERAL

1.1 GENERAL

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 15 and Division 16 section making reference to wires and cables specified herein.

1.2 RELATED SECTIONS

- A. Section 15900
- B. Section 16055
- C. Section 16010

1.3 REFERENCES

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; Latest Edition.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; Latest Edition.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Latest Edition.

1.4 DESCRIPTION OF WORK

- A. Extent of electrical wire and electrical cable work is indicated by drawings and schedules.
- B. Types of wire, cable and connectors in this section include the following:
 - 1. Copper conductors (low voltage power and control)
 - 2. Fixture wires
 - 3. Pigtail type connectors
 - 4. Tap type connectors
 - 5. Split-bolt connectors

- C. Applications for wire, cable and connectors in the section required for project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting circuitry
 - 3. Appliance and equipment circuitry
 - 4. Motor-branch circuitry
 - 5. Fire alarm circuitry
 - 6. HVAC controls
 - 7. Facility management systems

1.5 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical wire and cable products of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical wiring work similar to that required for project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wire, cable and connectors.
- D. UL Compliance: Comply with UL standards pertaining to wire, cable and connectors.
- E. UL Labels: Provide electrical wires, cables and connectors which have been UL-listed and labeled.
- F. NEMA/ICEA Compliance: Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of wire and cable.
- G. ANSI/ASTM: Comply with applicable portions of ANSI/ASTM standards pertaining to construction of wire and cable.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's data on wires and cables including dimensions, capacities, ratings, performance characteristics, gages and installation instructions.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable and connector):
1. Wire and Cable:
 - a. Advance Wire and Cable, Inc.
 - b. Cerro Wire and Cable Co.
 - c. Electrical Conductors, Inc.
 - d. General Cable Corp.
 - e. Hitemp Wires, Inc.
 - f. Rome Cable Corp.
 - g. Southwire Company
 - h. Triangle PWC, Inc.
 2. Connectors:
 - a. AMP, Inc.
 - b. Burndy Corp.
 - c. Gould, Inc.
 - d. Ideal Industries, Inc.
 - e. O-Z/Gedney Co.
 - f. Pyle National Co.
 - g. Thomas and Betts Co.

2.2 WIRE, CABLE AND CONNECTORS

- A. General: Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation.
- B. 600 Volt Wire:
1. Provide factor-fabricated wire of sizes, ratings, materials and types indicated for each service. Where not indicated, provide proper selection as determined by Owner to comply with project's installation requirements and NEC standards. Select from the following types, materials, conductor configurations, insulation and coverings:

UL Type: THHN

UL Type: THW

UL Type: THWN

UL Type: XHHW

Material: Copper

Conductors: Solid (AWG 12 and AWG 10 only)

Conductors: Concentric-lay-standard (standard flexibility)

Outer Covering: Cross-link polyethylene

Outer Covering: Thermoplastic

2. 600 volt conductors to be color coded as follows:

120/208 Volt Conductors:

Phase A - Black

Phase B - Red

Phase C - Blue

Neutral - White

Isolated Ground - Green with Orange Stripe

Equipment Ground - Green

277/480 Volt Conductors:

Phase A - Brown

Phase B - Orange

Phase C - Yellow

Neutral - Gray

Equipment Ground - Green

C. Cable:

1. Provide factory-fabricated cable of sizes, ratings, materials, and jacketing/sheathing as indicated for each type service. Where not indicated, provide proper selection as determined by Engineer to comply with installation requirements and NEC standards.

D. DDC System Multi-Conductor Instrumentation And Communication Cabling:

1. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC and General Purpose Cabling:
 - a. Cable shall consist of copper conductors not less No. 18 AWG stranded.
 - b. Shall be 2 or 3 conductor twisted cable with a drain wire.
 - c. Cable shall have a 100% overall shield.
 - d. Cable shall be plenum rated.
 - e. Cable shall meet or exceed NEC voltage rating of 300V.
 - f. Cable shall be NEC type CMP.
 - g. Cable shall meet or exceed UL temperature rating of plus 60 C.
2. Primary and Secondary Communications Network Cabling:
 - a. Cable shall be of type recommended by the DDC System Manufacturer.
 - b. Cable shall be shielded.
 - c. Cable shall be plenum rated.
 - d. Cable shall meet or exceed NEC voltage rating of 150V.
 - e. Cable shall meet or exceed UL temperature rating of plus 60 C.
 - f. Cable identified on installation drawings as "N2" shall be labeled at a minimum of every 18" with the DDC system manufacturer's name, system name, and the communications network name.
 - g. Each of the cable types shall be of a different color coding for easy identification and trouble shooting. Cable identified on installations drawings as "N2" shall be blue in color.
3. Room Sensor Cabling:
 - a. Cable shall consist of copper conductors not less No. 24 AWG.
 - b. Shall be multi-paired (at least two pairs) twisted cable.
 - c. Cable shall have a 100% overall shield.
 - d. Cable shall be plenum rated.
 - e. Cable shall meet or exceed NEC voltage rating of 300V.

- f. Cable shall be NEC type Article 800-CMP.
 - g. Cable shall meet or exceed UL temperature rating of plus 75 C.
- E. Connectors:
- 1. General: Provide factory-fabricated, metal connectors of sizes, ratings, materials, types and classes as indicated for each service. Where not indicated, provide proper selection as determined by Engineer to comply with installation requirements and NEC standards. Select from the following types, classes, kinds and styles.
 - Type: Pressure
 - Type: Crimp
 - Type: Threaded
 - Class: Insulated
 - Class: Non-insulated
 - Kind: Copper
 - Style: Butt connection
 - Style: Elbow connection
 - Style: Combined "T" and straight connection
 - Style: Insulation-piercing tap connection
 - Style: Split-bolt parallel connection
 - Style: Tap connection
 - Style: Pigtail connection

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to installation verify that interior of building has been protected from weather.
- B. Prior to installation verify that mechanical work likely to damage wire (and cable) has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. Interior Locations: Use only building wire, Type THW or THHN/THWN insulation, in raceway unless otherwise indicated on the Drawings.
- B. Wet or Damp Interior Locations: Use only building wire, Type THW or THHN/THWN in raceway or liquid tight flexible conduit.
- C. Exterior Locations: Use only building wire, Type THW or THHN/THWN insulation in raceway.
- D. Underground Installations: Use only building wire, Type THW or THHN/THWN insulation in raceway.
- E. Use wiring methods indicated on Drawings.

3.4 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits 24 volts and below. Minimum size shall be 16 AWG or as indicated on the contract drawings or approved vendor shop drawings.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits (including all fixture whips) and 120 volt control circuits.
- E. Conductors shall be continuous from outlet to outlet.
- F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet or where the distance to the first outlet exceeds 50 feet.
- G. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Protect exposed cable from damage.
- K. Support cables above accessible ceiling, unistrut, bridle rings, and cable ties to support cables. Do not rest cable on ceiling panels.
- L. Use suitable cable fittings and connectors.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

- P. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape as follows:
 - 1. Make a smooth assembly with 3-M Scotchfil insulating putty. Putty to fill all voids and be tapered to wire insulation to form a smooth transition.
 - 2. Finish with two 1/2 lapped layers of Scotch 33 plus plastic tape.
- Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- S. Route circuits at own discretion; however, circuit numbers shall be according to Drawings.
- T. On 3 phases, 4 wire systems, do not use a common neutral for more than 3 circuits. More than 3 circuit in any 1 conduit is not allowed without written permission from the Engineer.
- U. On single phase, 3 wire systems, do not use a common neutral for more than 2 circuits. More than 2 circuits in any 1 conduit is not allowed with written permission from the Engineer.
- V. Where a common neutral is run for 2 or 3 homerun circuits, connect phase conductors to breakers in panel which are attached to separate phase legs in order that the neutral conductors will carry only the unbalanced current. Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
- W. Run conductors of same circuit in same conduit.
- X. Run conductors of different voltage system in separate conduits.
- Y. All wire installed on the load side of branch GFI circuit breakers and isolation power panels shall be type "XHHW" or "XLP". Use of pulling compound on these conductors is prohibited.
- Z. Completely and thoroughly swab raceway before installing wire.
- AA. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- AB. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices

within 10 feet.

3.5 HVAC CONTROL SYSTEM WIRING

- A. All system input wiring shall be twisted shielded pair, minimum 18 gauge wire. All system analog output wiring shall be twisted shielded pair/3 wire as required, minimum 18 gauge wire. Preconfigured cables between terminal unit controllers and thermostats are acceptable, minimum 24 gauge.
- B. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.
- C. All Class 2 (24 VAC or less) wiring shall be installed in conduit unless concealed in accessible locations.
 - 1. Class 2 wiring, when not installed in conduit, shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Exposed wiring shall be installed parallel to the building structural lines. All exposed wiring shall be installed in accordance with NEC and local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.
- D. Low voltage control wiring and 24 VAC may be run in the same conduit. If the insulation ratings are equal (600V), power wiring 120 VAC and greater must be in a separate conduit.
- E. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size is 3/4".

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16055.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings in each junction box, control box, and in each panelboard.

3.7 FIELD QUALITY CONTROL

- A. Perform field inspection and testing.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

3.8 PROHIBITED USES

- A. Types AC and MC cables.
- B. Types NM, NMC, and NMS cables.

END OF SECTION 16120

SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical box and electrical fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
 - 1. Outlet boxes
 - 2. Junction boxes
 - 3. Pull boxes
 - 4. Floor boxes
 - 5. Conduit bodies
 - 6. Bushings
 - 7. Locknuts
 - 8. Knockout closures

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical boxes and fittings, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- D. Compliance: Provide electrical boxes and fittings which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test

electrical equipment.

- E. ANSI/NEMA Standards Compliance: Comply with ANSI C 134.1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports.

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 PRODUCTS

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized flat rolled sheet steel interior outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices. Gangable boxes are not acceptable.
 - 1. Interior Outlet Box Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.
 - a. Outlet Box Mounting Supports: Caddy™ Quick Mount Box Supports H-3 or approved straps or bars.
 - b. Outlet Box Extension Rings: Raco 700 series, square cut.
 - 2. Manufacturer: Subject to compliance with requirements, provide interior outlet boxes of one of the following:
 - a. Adalet-PLM Div, Scott and Fetzer Co.
 - b. Appleton Electric Co.
 - c. Bell Electric/Square D Co.
 - d. Eagle Electric Mfg. Co., Inc.
 - e. Pass and Seymour, Inc.
 - f. RACO, Inc.
 - g. Steel City/Midland-Ross Corp.
- B. Weatherproof Outlet Boxes: Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit. Hubs cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, including face plate gaskets and

corrosion-resistant fasteners.

1. Manufacturers: Subject to compliance with requirements, provide weatherproof outlet boxes of one of the following:
 - a. American Metal Forming Co.
 - b. Arrow-Hart Div., Crouse-Hinds Co.
 - c. Bell Electric/Square D. Co.
 - d. Gould, Inc.
 - e. Harvey Hubbell, Inc.
 - f. O-Z/Gedney Co.
 - g. Pyle-National Co.
- C. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seam and equipped with nuts, bolts, screws, and washers.
1. Manufacturer: Subject to compliance with requirements, provide junction and pull boxes of one of the following:
 - a. Adalet-PLM Div., Scott and Fetzer Co.
 - b. Appleton Electric Co.
 - c. Arrow-Hart Div., Crouse-Hinds Co.
 - d. Bell Electric/Square D Co.
 - e. GTE Corporation
 - f. Keystone Columbia, Inc.
 - g. O-Z/Gedney Co.
 - h. Spring City Elect Mfg. Co.
- D. Floor Boxes: Provide cast-iron waterproof adjustable floor boxes as indicated in concrete slabs on grade, with thread-conduit-entrance hubs, and vertical adjusting rings, gaskets, brass floor plates and flush duplex flap covers. Stamped steel floor boxes may be used on all floors above grade. Brass floor plate shall be compatible with type of floor finish.
1. Floor Box Accessories: Provide devices and accessories as indicated on the issued contract drawings.

2. Manufacturer: Subject to compliance with requirements, provide floor boxes of one of the following:
 - a. American Metal Forming Corp.
 - b. Bell Electric/Square D Co.
 - c. Crouse-Hinds Co.
 - d. Harvey-Hubbell, Inc.
 - e. Pyle-National Co.
 - f. Spring City Electrical Mfg. Co.
 - g. Steel City/Midland-Ross Corp.
 - h. Walker Mfg. Co.

- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of types, shapes and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws. Conduit bodies shall be compatible with conduit materials.
 1. Manufacturer: Subject to compliance with requirements, provide conduit bodies of one of the following:
 - a. Allen-Stevens Conduit Fittings Corp.
 - b. Appleton Electric Co.
 - c. Atlas Technologies, Inc.
 - d. Crouse-Hinds Co.
 - e. Gould, Inc.
 - f. Killark Electric Mfr. Co.
 - g. O-Z/Gedney Co.
 - h. Pyle-National Co.
 - i. Spring City Electrical Mfg. Co.

- F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and connectors of one of the following:
 1. Allen-Stephens Conduit Fittings Corp.
 2. Appleton Electric Co.

3. Atlas Technologies, Inc.
4. Burndy Corp.
5. Crouse-Hinds Co.
6. Gould, Inc.
7. O-Z/Gedney Co.
8. RACO, Inc.
9. Steel City/Midland-Ross Corp.
10. Thomas and Betts Co., Inc.

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings where indicated or required, complying with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- C. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture. Weatherproof covers shall be manufactured and installed so that the device is weatherproof during use (equal to RACO).
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install boxes and conduit bodies in those locations to ensure ready accessibility of electrical wiring.
 1. Provide each outlet box with the appropriate extension ring to suit wall thickness.
 2. Install boxes in a manner that preserves the Fire Resistance Ratings or shielding of partitions and other elements.
- F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.
- G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
 1. Securely mount each outlet box to metal studs with Outlet Box Mounting

Supports. If a bar or strap is used, secure to at least two metal studs.

2. The use of ceiling support wires or tie wires is not acceptable as support or mounting for electrical boxes. All electrical boxes shall be independently supported to structure.
- H. Provide equipment grounding connections for all installed boxes. This connection shall be made to the back of the box with an approved green grounding screw. All grounding connections shall be made via pig tails.
- I. No more than 4 gangs (4 openings for a single yoke) shall be permitted. Where additional requirements dictate more than four, another box with appropriate gangs shall be installed.
- J. Insulated throats or plastic bushings shall be installed at all conduit terminations.
- K. Secure fittings to the raceways by tightening set screws to the manufacturer's recommended torque.
- L. Boxes shall not be installed back to back in the same wall. If unavoidable, then the boxes shall have void between boxes completely filled with sound attenuation mineral fiber blanket. No through-the-wall boxes or nipples between boxes are to be used. If back to back boxes are connected, make the connection with flexible metal conduit. There shall be no rigid connections.
- M. All junction and outlet boxes used shall have the circuits contained within clearly marked on the cover.
- N. All fire alarm junction boxes shall be painted red. All fire alarm junction boxes over 4 inches square shall be equipped with terminal strips (labeled) for splice connections.
- O. All communications junction boxes shall be clearly labeled with system enclosed (e.g. "Intercom").

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- B. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes with Architect and vendor drawings prior to rough-in.
- C. Position outlet boxes to locate luminaires as shown on reflected architectural ceiling plan.

3.3 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closure in all unused box openings.

END OF SECTION 16135

SECTION 16140 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electrical energy.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles
 - 2. Switches
 - 3. Wall plates
 - 4. Dimmer controls
 - 5. Attachment plug
 - 6. Plug connectors
 - 7. Floor and counter-top service outlets

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in Manufacturer of wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring devices.
- D. Compliance and Labeling: Provide electrical wiring devices which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test electrical equipment and materials.

- E. NEMA Compliance: Comply with NEMA standards for general and specific-purpose wiring devices.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):
 1. Arrow-Hart
 2. Hampden
 3. Harvey Hubbell Inc.
 4. Leviton
 5. Lightolier
 6. Lutron
 7. Square D Co.
 8. Walker/Parkersburg Div., Textron Inc.

2.2 FABRICATED WIRING DEVICES

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and complying with NEMA Stds. Pub. No. WD 1. Where types and grades are not indicated, provide proper selection as determined by Architect/Engineer to fulfill wiring requirements, and complying with NEC and NEMA standards for wiring devices. Provide ivory color devices for all devices. All devices shall have side wired screw terminals.
- B. Receptacles:
 1. Commercial Specification Grade Duplex: Provide duplex commercial specification grade type receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears, nylon face, NEMA configuration 5-20R unless otherwise indicated. Hubbell 5362I/Arrow-Hart 5362I/Leviton 5362I.
 2. Ground-Fault Interrupter: Provide commercial specification grade, duplex receptacle, 2-pole, 3-wire, grounding type UL-rated Class A, Group 1, 20-amperes rating, 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; equip with 20 ampere

plug configuration, NEMA 5-20R. Hubbell GF 5362I/Leviton 5262I.

3. Commercial Specification Grade Duplex Isolated Ground: Provide duplex commercial specification grade type receptacles, 2-pole, 3-wire grounding, isolated ground connection with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears, nylon face, orange color, NEMA configuration 5-20R unless otherwise indicated. Provide Hubbell IG5362, Arrow-Hart #IG5362, or Leviton 5362-IG.
4. Surge Suppression Duplex: Provide commercial specification grade type receptacle UL Listed 1449 and 498, 2-pole, 3 wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 amperes, 125 volt with metal plaster ears, NEMA configuration 5-20R, nylon face, ivory color, constructed with four 18 mm MOV devices providing 210 joules protection per mode. Protection modes are Line-Neutral, Line-Ground, and Neutral Ground. Surge protection modules shall be constructed of glass PC board and have a conformal coating. Provide unit with a damage alert alarm with "muting", screw and a power-on/functional light. Provide Hubbell #5362IS or Arrow-Hart #5362SI. For isolated ground applications, provide (orange color) Hubbell #IG53620S, Arrow-Hart #IG5362S, or Leviton 5380-IG.

C. Plugs and Connectors:

1. Plugs: Provide grounding, armored cap plugs with cord clamp, and 0.4" cord hole; match NEMA configuration ampacity, voltage and wire quantity with power sources.

D. Switches:

1. Single Pole: Provide commercial specification grade flush single-pole quiet toggle switches, 20-ampere, 277-volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handle. Hubbell HBL 1221I/Arrow-Hart 1221I/Leviton 1221-2.
2. 3-way Snap: Provide commercial specification grade flush 3-way quiet switch, 20-amperes, 277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handles. Hubbell HBL 1223I/Arrow-Hart 1223I/Leviton 1223-2.
3. Four-Way: Provide commercial grade flush four-way quiet toggle switches, 20-amperes, 277-volt AC, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handle. Hubbell HBL 1224I/Arrow-Hart 1224I/Leviton 1224-2.

E. Dimmers:

1. Incandescent Single Pole Dimmers: Provide branch lighting solid-state AC dimmer controls for incandescent fixtures; wattage as indicated, 2000-watt minimum, 120-volts, 60 hertz, with continuously linear slide dimmer, ivory

nylon face plate, single-pole, soft-touch ON-OFF switch. Equip with electromagnetic filters to eliminate noise and interference, and with five inch length wire connecting leads. Lutron Nova N-2000, Lutron NLV-1500 (low voltage application), or approved equal.

2.3 WIRING DEVICE ACCESSORIES

- A. Wall Plates: Provide switch and duplex outlet wall plates for wiring devices, of types, sizes, and with ganging and cutouts as indicated. Where more than one device occurs, provide single piece-plates with appropriate cutout. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; all plates shall be thermo-plastic.
- B. Floor and Countertop Service Outlets: Provide service receptacle outlets and fittings of types and ratings indicated on the Drawings. All floor boxes installed in slab on grade shall be cast iron and floor boxes installed in slab above grade shall be stamped steel as manufactured by Walker.

PART 3 EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. Tighten connectors terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torque's specified in UL standard 486A. Use properly scaled torque indicating hand tool.
- E. Delay installation of wiring devices until wiring work is completed.
- F. Delay installation of wall plates until after wall finish completed. This Contractor shall remove and re-install plates for painting contractor.
- G. Mounting Heights:
 - Receptacles 18" above finish floor unless otherwise noted
 - Switches 48" above finish floor unless otherwise noted
- H. All outlets shown to be mounted above counter shall be mounted accessible. Exact location above counter and mounting configuration shall be coordinated with

Architect and Architectural millwork details.

- I. Install switches with off position down, receptacles with ground pin down and install all devices plumb and square.
- J. Connect wiring devices by wrapping conductor around side mounted screw terminal. Back-wired connections will not be acceptable.
- K. Use jumbo size plates for devices in masonry walls.
- L. All receptacles installed within 6' of any sink, hose bibb or other water source shall be of the GFI type as specified above. Any receptacle installed on the exterior of the building or outdoors shall be the GFI type.
- M. Use of feed-thru GFI protection is not allowed.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

- A. Upon installation of wall plates and receptacles, advise contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING

- A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated. Device grounding connection shall be made via a pig tail from the ground screw within the device backbox. Install in strict accordance with NEC Article 300-13 (b).

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16135 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor except surface mounted devices shall be mounted on top on baseboard.
- D. Install convenience receptacle 6 inches above counter unless noted otherwise.
- E. Install telephone and computer outlets 18 inches above finished floor except surface mounted devices shall be mounted on top of baseboard.
- F. Install fire alarm audio/visual and visual devices 6' - 8" above finish floor.
- G. Install fire alarm pull station 4' - 0" above finish floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 16140

SECTION 16155 - MOTOR STARTERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to motor starters specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Types of motor starter work are indicated by drawings and schedules and include (but are not limited to) the following:
 - 1. Manual with overload protection
 - 2. Full voltage, non-reversing starters
 - 3. Full voltage, non-reversing combination starters/disconnect switches
 - 4. Solid state electronic (Reduced Voltage)

1.3 QUALITY ASSURANCE

- A. Manufacturer: Firms regularly engaged in manufacturer of motor starters, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project.
- C. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motor starters.
- D. UL Compliance and Labeling: Comply with applicable requirements of UL 508, "Electric Control Equipment", pertaining to electrical motor starters. Provide units which have been UL-listed and labeled.
- E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to motor controllers/starters and enclosures.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on motor starters.
- B. Shop Drawings: Submit dimensioned drawings on motor starters showing accurately scaled equipment layouts and spatial relationship to associated motors, and connections to electrical power feeders and panels. All accessory components shall be clearly outlined and identified.
- C. Maintenance Data: Submit maintenance instructions for motor and drive replacements and spare parts listed. Include this data in maintenance manuals.
- D. Maintenance Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 5 units of each. Fuses shall be of a type available from a least 2 manufacturers.

- E. Maintenance Stock, Heaters: For types and ratings required, furnish additional heaters, amounting to 1 unit for each 9 installed, but not less than 3 units of each.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):
 1. Cutler Hammer
 2. General Electric Co.
 3. Square D Co.

2.2 MOTOR STARTERS

- A. General: except as otherwise indicated, provide motor starters and auxiliary components; of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations. Where more than one type of equipment meets indicated requirements, selection is Engineer's option. Provide phase loss and low voltage protection relay in the control circuits of all motors 7-1/2 HP and larger. Size 0 Starters shall be supplied as a minimum. Size 0 starters shall be provided in an oversized enclosure for control wiring. Provide fixed (6-10 seconds) time delay electronic relay in the control circuits of all motor 15 HP and larger connected to an emergency distribution system. Combination units shall be provided with integral non-fused disconnect or circuit breaker as indicated on the Drawings. Starters installed in existing motor control centers shall match existing equipment type, rating, etc.
- B. AC Fractional HP Manual Starters: Provide manual single-phase fractional HP motor starters of types, ratings and electrical characteristics indicated; equip with thermal overload relay for protection of 120 V AC motors of 1/2 HP and less. Provide starters with quick-make, quick-break trip free toggle mechanisms; mount starter in NEMA Type I general purpose enclosure.
- C. AC Full Voltages: Provide full voltage alternating current magnetic starters, consisting of contactors and overload relays mounted in common enclosures; of type, size, ratings and NEMA sizes indicated. Overload relays to be block type with manual reset. Control voltage to be supplied via 120 volt control transformer with fused primary and fused secondary and with a minimum of 2 sets of auxiliary contacts, (two-NO and two-NC) or as required for controls specified. Provide other control components as listed below and as directed by applicable Sections in Division 16.
 1. Green power off pilot light
 2. Red power on pilot light
 3. H-O-A selector switch
- D. Solid State Reduced Voltage: Provide full voltage alternating current solid state starters, consisting of SCR control components, microprocessor based technology, integral thermal sensors mounted in common enclosures; of type, size, ratings and NEMA sizes indicated. The starter shall be keyboard

programmable and have an alphanumeric display. The starter shall have electronic overload in both running and starting conditions. The overload function shall be selectable for either standard or heavy duty motor operation. Provide other features as listed below:

1. Output relays (2 N.O. and 2 N.C. auxiliary contacts)
2. Selection of acceleration modes
3. Adjustable voltage ramp
4. Kickstart feature for high static friction loads
5. Adjustable current limiting
6. Programmable starting torque
7. Energy saving feature for motors under light loads
8. Deceleration by injection of DC voltage "braking"
9. Adjustable deceleration ramp
10. Loss of load detection
11. SCR short circuit protection
12. Loss of input or output phase protection
13. 120 volt control transformer with fused primary and secondary
14. Green "power off" light/red "power on" light
15. H-O-A selector switch

PART 3 EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

- A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install fuses in fusible disconnects, if any.
- C. Install heaters, sized to provide protection in accordance with the manufacturer's recommendations and the NEC in overload relays.
- D. Coordinate auxiliary control requirements with mechanical contractor and application Section of Division 15.
- E. Provide identification as required by Section 16055.
- F. All 3 phase motors, 7-1/2 HP and larger, shall utilize electronic type starters.

3.2 ADJUST AND CLEAN

- A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

- A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 16155

SECTION 16160 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is a part of each Division 16 section making reference to panelboards specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include the following:
 - 1. Power-Distribution panelboards
 - 2. Lighting and appliance panelboards
 - 3. Load Centers
- C. Refer to other Division 16 sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for project.
- C. Special Use-Markings: Provide panelboards, constructed for special use, with UL marks indicating that special type usage.
- D. UL Compliance: Comply with applicable UL safety standards pertaining to panelboards and accessories, and enclosures; provide units which have been UL-listed and labeled.
- E. NEC Compliance: Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC articles pertaining to installation of wiring and equipment in hazardous locations.
- F. NEMA Compliance: Comply with NEMA Std. Pub. No. 250, "Enclosures for Electrical Equipment (1000 volt maximum)", Pub. No. 1 "Panelboards", and installation portion of Pub. No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".
- G. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of panelboard required.

Include data substantiation that units comply with requirements.

- B. Shop Drawings: Submit dimensioned custom drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not necessarily limited to, circuit breakers, fusible switches, fuses ground-fault circuit interrupters, and accessories. Manufacturer's standard catalog sheets are not acceptable.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data in maintenance manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of panelboard and enclosure):
 - 1. Square D Company
 - 2. General Electric Company
 - 3. Cutler-Hammer

2.2 PANELBOARDS

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with number of unit panelboard devices as required for complete installation. Where more than one type of component meets indicated requirements, selection is Installer's option. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.
- B. Power Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for copper conductors. Sub-feed breakers are not allowed unless otherwise noted on the Drawings. Construct unit for connecting feeder at top of panel. Equip with copper bus bars, and full-sized neutral bus; provide suitable lugs on neutral bus for out-going feeders requiring neutral connections. Provide molded-case main circuit breaker or main lugs only (as shown on the drawings) and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with internal common trip so overload on one pole will trip all poles simultaneously. Provide a bare un-insulated grounding bar bolted to enclosures. Provide panelboards fabricated by the same manufacturer as enclosures, and which mate properly with enclosures. Where specified provide isolated ground bus bar.
- C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangement shown; with anti-burn solderless pressure type lug connectors approved for copper conductor; construct unit for connecting feeders at top or bottom of panel as required; equip with copper bus bars, full-sized neutral bar, with bolt-in molded case circuit breakers; provide

suitable lugs on neutral bus for each outgoing feeder required; provide bare un-insulated grounding bar bolted to enclosure; and provide panelboards fabricated by same manufacturer as enclosures; and which mate properly with enclosures. Where specified provide isolated ground bus bar. The branch circuit breaker sub-assembly shall be in continuous contact and bolted to the panel enclosure back-box; sub-assemblies mounted on "Z" brackets are not allowed. The circuit breaker sub-assembly shall utilize thermo-plastic mounting straps to properly align breakers.

- D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Design enclosure for surface or recessed mounting as indicated on the drawings. Provide enclosures fabricated by same manufacturer as panelboards, and which match properly with panelboards to be enclosed.
- E. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to circuit breakers, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.
- F. Load Centers: Provide dead-front safety type load centers as indicated with overcurrent protective devices in quantities, ratings, types and arrangement shown with anti-burn solderless pressure type lug connectors approved for copper conductors, construct for reversible top or bottom feed. Equip with copper plated bus bars, full size neutral and plug-on circuit breakers. Provide suitable lugs on neutral bus for each outgoing branch required. Provide bare un-insulated grounding bar bolted to enclosure. Provide load centers fabricated by same manufacturers as enclosure.

PART 3 EXECUTION

3.1 INSTALLATION OF PANELBOARDS

- A. General: Install panelboards and enclosures where indicated, in accordance with manufacturer's written instructions applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
- D. Provide electrical connections within enclosures.
- E. Fill out (typewritten) panelboard's circuit directory card upon completion of installation work.
- F. Provide identification as required by Section 16055 and as required by the National Electrical Code, 2005 Edition.

- G. Provide a minimum of 6 spare circuit breakers (or more if indicated on the Drawings) in each panelboard and install a minimum of 6 spare 3/4" conduits from each flush mounted panelboard/load center to above an accessible ceiling.
- H. External handle tie type circuits breakers are not acceptable.

END OF SECTION 16160

SECTION 16190 - SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to supports, anchors, sleeves, and seals specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division 16 sections.
- B. Types of supports, anchors, sleeves and seals specified in this section include the following:
 - 1. C-clamps
 - 2. I-beam clamps
 - 3. One-hole conduit straps
 - 4. Two-hole conduit straps
 - 5. Round steel rods
 - 6. Lead expansion anchors
 - 7. Toggle bolts
 - 8. Wall and floor seals
 - 9. Conduit and box fasteners
- C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 16 sections.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in Manufacturer of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on

projects with electrical installation work similar to that required for this project.

- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical supporting devices.
- D. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA Std. Pub. No. FB1, "Fittings and Supports for Conduit and Cable Assemblies".
- E. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
- F. UL Compliance: Provide electrical components which are UL-listed and labeled.
- G. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining strap for conduit, pipe and cable.

1.4 SUBMITTALS

- A. Product Data: Submit catalog cuts, specifications, installation instructions, for each type of support, anchor, sleeve and seal. Submit hanger and support schedule showing manufacturer's figure number, size, location, and features for each required hanger and support.

PART 2 PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

- A. General: Provide supporting devices complying with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for a complete installation, and as herein specified. Where more than one type of device meets the following requirements, selection is Installer's option.
- B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
 - 1. C-Clamps: Black malleable iron; 1/2" rod size; approx. 70 pounds per 100 units.
 - 2. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.
 - 3. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approx. 7 pounds per 100 units.
 - 4. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
 - 5. Hexagon Nuts: For 1/2" rod size; galvanized steel; approx. 4 pounds per

- 100 units.
6. Round Steel Rod: Black steel; 1/2" dia.; approx. 67 pounds per 100 feet.
 7. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approx. 200 pounds per 100 units.
 8. Conduit and Box Fasteners: Fasteners specifically manufactured for the support of conduit and electrical boxes, UL labeled.
- C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:
1. Lead Expansion Anchors: 1/2"; approx. 38 pounds per 100 units.
 2. Toggle Bolts: Springhead; 3/16" x 4"; approx. 5 pounds per 100 units.
 3. Manufacturer: Subject to compliance with requirements, provide anchors of the following:
 - a. Abbeon Cal Inc.
 - b. Ackerman Johnson Fastening Systems, Inc.
 - c. Elcen Metal Products Co.
 - d. Ideal Industries, Inc.
 - e. Joslyn Mfg. and Supply Co.
 - f. McGraw Edison Co.
 - g. Rawlplug Co., Inc.
 - h. Star Expansion Co.
 - i. U.S. Expansion Bolt Co.
 - j. Caddy-Erico Product, Inc.
 - k. Hitt-Thomas Industries, Inc.
- D. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated; and having the following construction features:
1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- E. Conduit Cable Supports: Provide cable supports with insulating wedging plug for

non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable iron casting with hot dip galvanized finish.

F. U-Channel Strut Systems:

1. Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:
 - a. Fixture hangers
 - b. Channel hangers
 - c. End caps
 - d. Beam clamps
 - e. Wiring stud
 - f. Thinwall conduit clamps
 - g. Rigid conduit clamps
 - h. Conduit hangers
 - i. U-bolts
2. Manufacturer: Subject to compliance with requirements, provide channel systems of one of the following:
 - a. B-Line Systems, Inc.
 - b. Elcen Metal Products Co.
 - c. Greenfield Mfg. Co., Inc.
 - d. Midland-Ross Corp.
 - e. Power-Strut Div; Van Huffel Tube Corp.
 - f. Unistrut Div; GTE Products Corp.

2.2 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls

below grade or in exterior walls. All sleeves shall be made watertight.

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

- A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.
 - 1. The use of support wires or tie wires is not acceptable as support for boxes conduit, or equipment.
 - 2. Boxes in ceiling spaces shall be rigidly supported from a structural member of the building directly or by using a metal brace. The metal brace shall be a minimum of 1/4" all thread rod.
- B. Coordinate with other electrical work, including raceway and wiring box and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports within maximum spacings indicated.
- D. All void spaces within or around sleeves shall be filled with approved fire sealant.

END OF SECTION 16190

SECTION 16452 - GROUNDING AND GROUND-FAULT PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification section apply to work of this section.
- B. Division 16 Basic materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Extent of grounding and ground-fault protection work is indicated by drawings and schedules.
- B. Types of grounding and ground-fault protection in this section include the following:
 - 1. Grounding:
 - a. Metal building frames
 - b. Separately derived systems
 - c. Enclosures
 - d. Systems
 - e. Equipment
 - 2. Ground-Fault Protection:
 - a. Ground-fault circuit interrupters
- C. Requirements of this section apply to electrical grounding and ground-fault protection work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of grounding and ground-fault protection units of types and ratings required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with grounding and ground fault installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to electrical grounding and ground-fault protection systems.

- D. ANSI/IEEE Compliance: Comply with C114.1 (IEEE Std 142) and IEEE Stds Nos. 241 and 242 pertaining to grounding and ground-fault protection of power systems.
- E. ANSI/UL Compliance: Comply with requirements of ANSI/UL and UL standards pertaining to grounding and ground-fault protection equipment and devices. Provide products which have been UL-listed and labeled.
- F. NEMA Compliance: Comply with NEMA Stds Pub Nos. PB 1.2 and AB 1, pertaining to construction and installation of ground-fault protection devices and molded-case circuit breakers.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on grounding and ground-fault protection equipment and devices.
- B. Maintenance Data: Submit maintenance instruction and spare parts lists. Include this data in maintenance manuals.

PART 2 PRODUCTS

2.1 GROUNDING

- A. Materials And Equipment:
 - 1. Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cable/wires, connectors, terminals (solderless lugs), bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for application indicated.
 - 2. Provide conduit, duct and fittings complying with Division 16 Basic Materials and Methods section, "Raceways", in accordance with the following listing:
 - a. Rigid steel conduit
 - b. Electrical metallic tubing
 - c. Flexible metal conduit, Type 2
 - d. Liquid-tight flexible metal conduit
 - e. Rigid metal conduit fittings
 - f. EMT fittings, Type 1
 - g. Flexible metal conduit fittings
 - h. Liquid-tight flexible metal conduit fittings

- B. Electrical Grounding Conductors:
 - 1. Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. All grounding conductors shall be copper.
- C. Bonding Plates, Connectors, Terminals and Clamps:
 - 1. Provide electrical bonding plates, connectors, terminals and clamps as recommended by bonding plate, connector, terminal, and clamp manufacturer's for indicated applications.

2.2 GROUND FAULT PROTECTION DEVICES

- A. General: Except as otherwise indicated, provide ground-fault protection devices and components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.
- B. Circuit Interrupters/Circuit-Breakers: Provide 1" wide module bolt-on panelboard circuit breakers, with integral ground-fault circuit interrupters, UL-rated Class A, Group 1; with ampacity rating, pole construction, voltage and asymmetric interruption capacity as shown on the drawings. Provide with solid-state ground-fault sensing and signaling, with 5 milliamperes ground-fault sensitivity, +/-1 milliamperes. Equip with PUSH-TO-TEST capability. Provide modules which fit panelboards in which they are located.
- C. Manufacturer: Subject to compliance with requirements, provide ground-fault circuit interrupters of one of the following:
 - 1. Cutler-Hammer
 - 2. General Electric Company
 - 3. Square D Company

PART 3 EXECUTION

3.1 INSTALLATION OF GROUNDING AND GROUND-FAULT PROTECTION SYSTEMS

- A. Install electrical grounding systems and ground-fault protection devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding and ground-fault protection devices comply with requirements. Comply with requirements of NEC, NESC, and NEMA standards for installation of grounding and ground-fault protection systems and devices.
- B. Coordinate with other electrical work as necessary to interface installation of grounding system and ground-fault protection devices with other work.

- C. Install clamp-on connectors only on thoroughly cleaned metal contact surface, to ensure electrical conductivity and circuit integrity.
- D. All wire used on the load side of branch GFCI protective devices shall be Type XHHW, XLP, or equivalent. Wiring pulling compound shall not be used on this wiring to facilitate installation.
- E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- F. Size and type of green equipment ground conductors and method of securing them to obtain electrical continuity and effective grounding as per National Electrical Code, Article 250. Conduit shall not be used for the primary grounding means, but shall be electrically continuous for use as a supplemental grounding system.
- G. Neutrals of lighting systems shall be grounded independently and in accordance with the National Electrical Code.
- H. All metal raceway system, including cabinets, conduit and boxes, shall be grounded to a water pipe with UL approved grounding clamp in accordance with the National Electrical Code.
- I. An equipment ground conductor shall be installed in all conduits.

3.2 TESTING

- A. Upon completion of installation of ground-fault protection devices and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then re-test to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
- B. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 3 ohms, take appropriate action to reduce resistance to 3 ohms or less by driving additional ground rods and/or by chemically treating soil encircling ground rods with sodium chloride, calcium chloride, copper sulfate, or magnesium. Then re-test to demonstrate compliance.

END OF SECTION 16452

SECTION 16475 - SURGE SUPPRESSION

PART 1 GENERAL

1.1 DESCRIPTION: The Electrical Contractor shall furnish all labor, materials, equipment and services necessary for and incidental to the installation of the Transient Voltage Surge Suppression (TVSS) System. Components are as specified herein.

1.2 RELATED DOCUMENTS AND APPLICABLE STANDARDS

- A. Systems shall be designed, manufactured, tested, and installed in accordance with the latest edition of the following standards:
 - 1. Underwriters Laboratories (UL 1449, Second Edition)
 - 2. National Electrical Manufacturers Association (LS 1)
 - 3. American National Standards Institute (C62.41)
 - 4. Institute of Electrical and Electronic Engineers (Std 1100)
 - 5. Military Standards (MIL-STD 220A)
 - 6. National Electrical Code (Article 285)
- B. The system shall be UL 1449 listed as a complete system under the UL 1449 standard for Transient Voltage Surge Suppressors. Systems not UL 1449 listed are not acceptable.

1.3 SUBMITTALS

- A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
- B. Equipment Manual: The manufacturer shall furnish an installation manual with installation, start-up, and operating instructions for the specified system.
- C. UL 1449 Ratings: Documentation of specified system's UL 1449 listing and suppressed voltage ratings (SVR) shall be included as required product data submittal information.
- D. Maximum Surge Current Test Reports demonstrating that the TVSS has been tested to the specified rating. Reports will clearly demonstrate that the tests have been performed on a COMPLETE device including all necessary fusing, disconnects, monitoring systems, etc.
- E. Minimum Repetitive Surge Current Rating. Provide data demonstrating that the device is capable of surviving the minimum specified repetitive rating.
- F. Short Circuit Current (AIC). Provide test reports demonstrating that the device has been tested to the specific AIC rating.
- G. Full NEMA LS1 data package per the requirements of this standard.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements and subject to providing the required submittal data, provide devices of one manufacturer:
 - 1. Innovative Technology, Inc.
 - 2. L.E.A. International
 - 3. Liebert Corporation

2.2 EQUIPMENT

- A. Equipment shall be a parallel protector rated for 3 phase, 4 wire applications.
- B. The equipment maximum surge current capacity, based on an 8 x 20 microsecond waveform per ANSI/IEEE C62.41 Category C3 rating, shall be a minimum of 125,000 amps per mode.
- C. The TVSS shall be capable of withstanding over 15,000 sequential 10,000 Amp ANSI/IEEE C62.41 Category C3 impulses without degradation or failure. Manufacturers will provide a higher maximum surge current rating in order to meet the repetitive (longevity) requirements in this paragraph.
- D. Each module must have an indicator light to report status of the module. A corresponding indicator must be mounted on the front of the panel.
- E. Protection modes: The TVSS shall provide Line to Ground (L-G), Line to Line (L-L), Line to Neutral (L-N), and Neutral to Ground (N-G) protection.
- F. Status alarm monitor, surge counter, audible alarm and remote status monitors shall be provided. The TVSS will also be equipped with a built-in push-to-test feature that tests the integrity of each MOV/fuse pair.
- G. The system performance ratings shall be based on the UL 1449, Second Edition Suppressed Voltage Rating (SVR). The maximum UL 1449 SVR for each of the specified protection modes shall be:
 - 1. 700 volts L-N for 277/480 volt systems.
 - 2. 330 volts L-N for 120/208 volt systems.

PART 3 EXECUTION

3.1 INSTALLATION OF THE TVSS SYSTEMS

- A. The preferred specified system shall be installed within the gear protected, but if submitted as a separate unit, to be installed no further than 3 feet in total wire lead length(s) distance from the power conductor(s) it is protecting and shall avoid any unnecessary bends. Terminals shall be provided for all necessary power and ground connections.
- B. The specified system shall be provided with an internal safety interlocked disconnect system providing no interruption to the protected load for testing and maintenance. System shall not require removal and replacement for warranty or other repairs. All internal component replacements shall be capable of being completed by a licensed electrician.
- C. Other materials and equipment shall comply with applicable Sections of this Division.

3.2 TESTING

- A. Conduct manufacturer's standard factory tests per approved submittal data.
- B. Submit formal report of factory tests within 10 days of factory tests, stating tests conducted, acceptable limits of such tests, actual test results, and original test data sheet with legible signatures of those conducting, witnessing, and approving such tests.
- C. The system shall be tested to MIL-STD 220A for electrical line noise attenuation

per 50 ohm insertion loss measurement method of radio frequencies up to 100 MHz.

3.3 WARRANTY

- A. Manufacturer shall provide a product warranty for a period of not less than 5 years from date of installation. Warranty shall cover unlimited replacement of system protection modules during the warranty period.

END OF SECTION 16475

SECTION 16510 - INTERIOR BUILDING LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Division 16 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Extent of interior lighting fixture work is indicated by drawings and schedules.
- B. Types of interior lighting fixtures in this section include the following:
 - 1. Fluorescent
 - 2. Incandescent
 - 3. HID
 - 4. Compact Fluorescent
- C. Applications of interior lighting fixtures required for project include the following:
 - 1. General lighting
 - 2. Supplementary lighting
 - 3. Task lighting
 - 4. Emergency lighting
- D. Lighting Control
 - 1. Relay Panels
 - 2. Occupancy Sensors

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of interior lighting fixtures of types, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with interior lighting fixture work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to installation and construction of interior building lighting fixtures.
- D. NEMA Compliance: Comply with applicable requirements of NEMA Std Pub. Nos. LE1 and LE2 pertaining to lighting equipment.”
- E. ANSI/IES: Comply with ANSI 132.1 pertaining to interior lighting fixtures.
- F. ANSI/UL Compliance: Comply with ANSI/UL standards pertaining to interior lighting fixtures for hazardous locations.
- G. UL Compliance: Provide interior lighting fixtures which have been UL-listed and labeled.
- H. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association Standards and carry the CBM label.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on interior building lighting fixtures
- B. Shop Drawings: Submit dimensioned drawings of interior lighting fixtures installations, including but not necessarily limited to, layout, relation to associated panelboards, and connections to panelboards. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data in maintenance manuals.
- D. Maintenance Stock: Submit the following items of maintenance stock prior to substantial completion:
 - 24 fluorescent lamps of each type
 - 12 incandescent lamps of each type
 - 2 each of each other type of lamp

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of manufacturers as listed in the lighting fixture schedule.

2.2 INTERIOR LIGHTING FIXTURES

- A. General: Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters and wiring.
- B. Fluorescent-Lamp Ballasts: Provide high efficiency energy-saving electronic technology type fluorescent-lamp ballasts, capable of operating lamp types indicated; with high power factor, Class P sound rated A, THD less than 10%, crest factor less than 1.7, 90% power factor or more, shall withstand line transients as defined in ANSI/IEEE C62.41 (Category A), shall have a frequency of operation of 20 KHZ or greater, shall meet FCC Rules and regulations, Part 18, Class A, and low-noise features; sound-rated A, and with internal thermal protection; similar and equivalent to Motorola, Advance or Magnetek.
 - 1. Ballasts for 4 lamp operation shall be parallel type.
- C. Compact Fluorescent Lamp Ballasts: Provide high efficiency electronic ballast capable of operating lamp types specified, with high power factor, low noise, sound rated A, THD of 10% with internal thermal protection. Provide Motorola, Advance, or Magnetek. Compact fluorescent ballast as manufactured by ESI will not be accepted.
- D. High Intensity Discharge (HID) Ballast:
 - 1. Description: ANSI C82.4, HID ballast as required
 - 2. Provide ballast suitable for lamp specified
 - 3. Voltage: Match luminaire voltage
- E. Emergency Ballasts:
 - 1. All emergency ballasts shall be equal to Bodine B-50ST with a 5 year warranty.

- F. Interior Lighting Fixture Types:
1. Interior lighting fixture types are scheduled on the drawings.
- G. Lamps: T8 type:
1. Phillips "Alto"
2. Osram Sylvania "Eco"
3. GE "Ecolux"
- Color temperature of lamps shall be as indicated in fixture schedule on drawings. All lamps to be designated as "low mercury" content meeting all federal TLCP requirements.
- H. HID Lamps:
1. Acceptable Manufacturers:
a. General Electric
b. Phillips
c. Osram Sylvania
2. All HID lamps to be color corrected for color uniformity (CRI > 85). All lamps to match in stock lot, color, lumens per watt, mounting position, manufacturer, etc.
- I. Exit Signs:
1. Manufacturers: As schedules on Drawings
2. Description: Exit sign fixture
3. Housing: High-impact thermoplastic
4. Face: As scheduled on Drawings
5. Directional Arrows: As indicated on Drawings
6. Mounting: As indicated on Drawings
7. Battery: As scheduled on Drawings
8. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within 12 hours.
- J. Relay Panels:
1. Relay panel shall be populated with up to 24 relays and provided with Network or Remote control module.
2. Relay panel to meet or exceed specifications equal to Lithonia Z-Max relay panel.
- K. Occupancy Sensors:
1. Occupancy Sensors to meet or exceed specifications equal to Lithonia.

PART 3 EXECUTION

3.1 INSTALLATION OF INTERIOR LIGHTING FIXTURES

- A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of interior lighting fixtures with other work.
- C. Fasten fixtures securely to indicated structural support; and check to ensure that

solid pendant fixtures are plumb.

- D. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire. Final connection to light fixture from junction box shall be made in flexible conduit (6' maximum length). Flexible conduit connections between fixtures will not be accepted.
- E. Bond products and metal accessories to branch circuit equipment grounding conductor.
- F. Install specified lamps in each luminaire, emergency lighting unit and exit sign.
- G. All fixtures shall be guaranteed for a period of one year after final acceptance and any defects in material or workmanship during this period shall be replaced or repaired to the Architect's satisfaction without extra cost.
- H. All supports, safety chains, swivels, etc. shall be furnished as required for a complete installation.
- I. Install all lamps in fixtures of contiguous spaces with the same lot, type and color lamp. Install all lamps at the same time for consistent burn in and operation.

3.2 ADJUST AND CLEAN

- A. Clean interior lighting fixtures of dirt and debris upon completion of installation and touch up damage.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Aim and adjust luminaries as indicated on drawings or as directed.
- D. Adjust exit sign directional arrows as indicated.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of interior lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- B. Group relamp luminaries in contiguous space if any fixtures have failed lamps at substantial completion. Fluorescent lamps that fail within the first 90 days of operation will be considered defective and shall be replaced at no extra cost.

3.4 GROUNDING

- A. Provide secure equipment grounding connections for each interior lighting fixture installation where indicated.

END OF SECTION 16510

SECTION 16670 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Strike (air) terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

1.2 RELATED REQUIREMENTS

- A. Section 16452 - Grounding and Bonding for Electrical Systems: Electrical system grounds.
- B. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.3 REFERENCE STANDARDS

- A. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2020.
- B. UL 96 - Lightning Protection Components Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
 - 1) Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.
 - 2) If concrete-encased grounds are to be used and are not shown in Contract Documents, provide sufficient data to determine concrete encasement dimensions and location.
 - 3) Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.
 - 4) Include engineering analysis of equalization of potential to metal bodies within the structure.
 - 5) Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.
 - 6) Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 7) Installation Certification: Submit copy of certification agency's approval.
 - 8) Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced system design standard on site.
- B. Manufacturer Qualifications: Company specializing in lightning protection equipment with minimum three years documented experience.
- C. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years documented experience.
- D. Installer Qualifications: Capable of providing the specified certification of the installed system.
- E. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LIGHTNING PROTECTION COMPONENTS:

- 1) Harger Lightning and Grounding
- 2) National Lightning Protection Corporation
- 3) Robbins Lightning, Inc
- 4) thermOweld, subsidiary of Continental Industries; division of Burndy LLC:

B. LIGHTNING PROTECTION SYSTEM

- 1) Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.

- 2) PROVIDE SYSTEM THAT PROTECTS:

- i. The entire structure.
- ii. Open air areas within 100 feet of exterior walls at grade level.
- iii. Open air areas within building footprint.
- iv. Coordinate with other grounding and bonding systems specified.
- v. Treat isolated non-grounded protruding metal items as specified by NFPA 780 for heavy-duty stacks.
- vi. Determine ground resistance by field measurement.
- vii. Provide copper, bronze, or stainless steel components, as applicable; no aluminum.
- viii. Provide system certified by Underwriters Laboratories or the Lightning Protection Institute.

- b) Strike Terminals: Provide strike (air) terminals on the following:

- i. Roofs.
- ii. Penthouse roofs.
- iii. Parapets.
- iv. Roof mounted equipment.
- v. Stacks.

- 3) COMPONENTS

- a) All Components: Complying with applicable requirements of UL 96.
- b) Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.
- c) Grounding Rods: Solid copper.
- d) Ground Plate: Copper.
- e) Conductors: Copper cable.
- f) Connectors and Splicers: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Coordinate work with installation of roofing and exterior and interior finishes.

3.2 INSTALLATION

- A. Install in accordance with referenced system standards and as required for specified certification.
- B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.
- C. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.
- D. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

END OF SECTION 16670

SECTION 16721 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. Refer to applicable Division 15 section for duct detectors at air handling units and subsequent control requirements of all motors, smoke dampers, and other pertinent HVAC equipment.
- C. The complete installation shall conform to the applicable section of NFPA-101, Local Code Requirements and National Electrical Code with particular attention to Article 760.

1.2 DESCRIPTION OF WORK

- A. The work covered by this section of the specifications includes the furnishings of all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the drawings and as herein specified.
- B. Types of fire alarm and detection systems in this section include the following: Combination, Zoned, Non-Coded, and Addressable.

1.3 QUALITY ASSURANCE:

- A. **Manufacturers:** A firm regularly engaged in manufacturer of fire alarm and detection systems, of types and sizes, and electrical characteristics required, whose products have been in satisfactory use in similar service for no less than 5 years. Each and all items of the Fire Alarm Systems shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable to comply with UL864 requirements.
- B. **Installer:** Qualified with at least 5 years of successful installation experience on projects with fire alarm and detection system installation work similar to that required for project.
- C. **Code Compliance:** Comply with all NFPA Requirements as applicable to construction and installation of fire alarm and detection components and accessories.
- D. **UL Compliance and Labeling:** Provide fire alarm and detection system components which are UL-listed and labeled.
- E. **FM Compliance:** Provide fire alarm and detection systems and accessories

which are factory mutual approved.

1.4 SUBMITTALS

A. General:

1. Material and documentation submitted shall be in accordance with Sections 01300 and 16010.
2. Incomplete or partial submittals will not be reviewed nor approved until all requested items are provided to the A/E. Completeness of the submittal is the sole responsibility of the Contractor.
3. Sufficient information, clearly marked, shall be presented in order for the reviewer to determine compliance with contract documents. Unmarked submittals shall be returned un-reviewed.
4. Equipment proposed shall be from one (and only one) of the companies listed under "ACCEPTABLE MANUFACTURERS". Proposed substitute equipment will not be reviewed by the A/E.
5. A complete submittal shall contain:
 - a. Product Descriptions,
 - b. Floor Plans, and
 - c. O & M Manual.

B. Product Descriptions:

1. Provide manufacturer's standard catalog sheets for fire alarm system devices proposed. This shall include (but not limited to) smoke detectors, heat detectors, control modules, and notification appliances.
2. Each item proposed shall be clearly marked with complete part numbers.

C. Floor Plans:

1. Provide large scale drawings (24" x 36" or 32" x 42"). Drawings shall be produced with a "CAD" program. Photocopies floor plans from the contract document set is unacceptable. 8-1/2" x 11" drawings are also unacceptable.
2. Floor plans shall show as a minimum: 1/8 scale walls, rooms with names and numbers, fire alarm device locations, symbol legend, conduit (if applicable) routing, junction box (if applicable) locations, wire and cable types and counts.

D. O & M Manuals:

1. Manuals shall be bound into "book" form and marked "O & M Fire Alarm

System Manual".

2. Manuals shall contain system operating information along with component technical sheets.
3. Manuals shall contain system component interconnection wiring diagrams marked as applicable for this project. General wiring diagrams are unacceptable.
4. Manuals shall provide clear and concise information on such items (but not limited to):
 - a. Basic Troubleshooting
 - b. Contact Information for Repair and Maintenance

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Products in this specification are based on Simplex Grinnell herein described and as indicated on the drawings and was basis of design.
 1. EST
 2. Siemens
 3. Simplex Grinnell

2.2 FIRE ALARM AND DETECTION SYSTEMS

- A. General:
 1. Furnish and install devices as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition. Include sufficient Zone Adapter Modules, addressable manual stations, automatic fire detectors, smoke detectors, duct detectors, audible and visual signal devices, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
 2. All peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The catalog numbers specified under this section are those of Simplex Time Recorder Co. and constitute the type, product quality, material, and desired operating features.
- B. Fire Control Panel: The Fire Alarm Control Panel is an existing Simplex 4020.
- C. Remote Annunciators: Where shown on the plans, provide and install an LCD annunciator. The annunciator(s) shall be recessed mounted in a six gang backbox and provide 2 lines of 40 characters display. The display shall be "back lighted" with LED's. The annunciator shall be provided with front panel control

switches for SYSTEM ACKNOWLEDGE, ALARM SILENCE, and SYSTEM RESET. Four programmable switches shall also be provided. The annunciator shall communicate over the system shielded twisted pair cable. Point wired annunciators are not acceptable. The annunciator shall be 24 VDC powered from the fire alarm control panel. Provide annunciator(s) equivalent to Simplex #4603-9101.

- D. Multiple Addressable Peripheral Network (MAPNET): Wiring types will be approved by the equipment manufacturer. Existing wiring will be utilized in retrofit applications. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Class B circuit. Class A communications will be provided where shown on the drawings. Wire will be so routed to maintain sufficient distance between the forward and return loop as called for by the authority having jurisdiction. To minimize wire routing and to facilitate future additions, t-tapping of the communications channel will be supported except where Class A wiring is required.

E. Materials and Equipment:

1. The addressable devices specified below must be capable of communicating with the existing system control panel. The location of addressable devices will be selected along with conventional devices to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.
2. All addressable smoke and heat detector heads as specified below will be pluggable into their bases. The base will contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Different detector heads (smoke or heat) must be interchangeable. Upon removal of the head a trouble signal will be transmitted to the control panel.
3. Addressable Pull Stations: Addressable pull stations will contain electronics that communicate the station's status (alarm, normal) to the FACP over 2 wires which also provide power to the pull station. The address will be set on the station. They will be manufactured from high impact red Lexan. The station will mechanically latch upon operation and remain so until manually reset by opening with a key combo to all system locks. Pull stations will be single action, #2098-9784 with trim plate in matching red. Mounting height shall be 48-inches above finish floor unless noted otherwise.
4. Zone Adapter Module: Zone Adapter Modules shall be used for monitoring of water flow, valve tamper, non-addressable smoke and heat detectors, and for control of alarm indicating appliances, AHU systems, and magnetically held doors.
 - a. An addressable interface module shall be provided for interfacing normally open direct contract devices to an addressable initiating circuit. The device shall be a Simplex type Zone Adapter Module

(ZAM).

- b. ZAM's will be capable of mounting in a standard electric outlet box. ZAMs will include cover plates to allow surface or flush mounting. ZAMs will receive their 24VDC power from a separate two wire pair running from an appropriate power supply.
- c. There shall be two types of devices:
 - 1) Type 1: Monitor ZAM
 - 2) Type 2: Control ZAM
- d. For Type 1 above:
 - 1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. This type of addressable device module will provide power to and monitor the status of a zone consisting of conventional 2-wire smoke detectors and/or N/O contact devices as specified elsewhere. The supervision of the zone wiring will be Class B. These ZAMs will communicate the zone's status (normal, alarm, trouble) to the FACP. Model #2190-9155/56 for surface/flush mounting.
 - 2) For conventional 4-wire smoke detector with Class B wiring supervision. This type of addressable device will provide power to and monitor the contact status of a zone consisting of conventional 4-wire smoke detectors as specified elsewhere. The ZAM will provide detector reset capability and a 2 ampere fuse to 4-wire detector. These ZAMs will communicate the zone's status (normal, alarm, trouble) to the FACP. Model #2190-9157/58 for surface/flush mounting.
- e. For Type 2 above:
 - 1) Zone Adapter Module: For chimes and strobe signals signal devices. This type of addressable device will provide double pole double throw relay switching that can be used to connect through easily replaceable 2 amp fuses: a zone of signals to a power source; speakers to an audio source; fire fighter phone jacks to a communications channel or activate a variety of controlled devices. The module will be available in either a Class B or Class A supervision version. In the Class B version the wiring will be supervised by an end-of-line device. Class B devices will be provided. These ZAMs will communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and will receive a command to transfer the

relay from the fire alarm control panel. Model #2190-9161-62 for surface/flush mounting.

- 2) Zone Adapter Module: For non-suppressed control. This type of addressable device will provide double pole double throw relay switching for loads up to 120 VAC. It will contain easily replaceable 2 amp fuses, one on each common leg of the relay. The ZAM shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the ZAM become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel. The ZAM shall be capable of being programmed for its "Address" location on the addressable device initiating circuit. The ZAM shall be compatible with addressable manual stations and addressable detectors on the same addressable initiating circuit. Model #2190-9163/64 for surface/flush mounting.
5. Photoelectric Smoke Detector. Provide type 2098-9201 Photoelectric Smoke detector heads with type 2098-9637 bases as shown on the plans. Detectors shall be of the solid state photoelectric type utilizing a stable LED light source and a silicone photo diode as the receiving element to form a highly accurate means of smoke detection. Internal detector circuits shall be shielded against electrical interference and resistant to transients, "noise and RF interference". Nominal detector sensitivity shall be 1.4% per foot obstruction with a range of 1% to 1.84%. Regardless of sensitivity settings, the detector's stability shall be unaffected by high air velocity. No radioactive materials shall be used.
6. Heat Detector: Automatic heat detectors shall be combination rate or rise and fixed temperature type. When the fixed temperature portion is activated, the units shall be non-restorable and give visual evidence of such operation. Heat detectors shall be Simplex Type 2098-9400 series.
7. Audiovisual Chime-Strobe:
 - a. Chimes: Chimes shall be Simplex type 2902-9207. The chime shall be polarized and shall be operated by 24 VDC with a minimum of 82 dB at 10 ft. Adaptors shall allow surface, semi-flush, weather resistance, or audio/visual mounting as shown on the plans. It shall provide 4 connections to insure properly supervised in/out system connection. Chime motor shall be capable of accepting chime kit or bell gong without replacement of entire unit. Chime shall be UL Listed for its intended purpose. Mounting height shall be 7' - 0" above finish floor unless noted otherwise.
 - b. Visual Flashing Lamps (Xenon Strobe): Visual indicating

appliances shall be Simplex type 4903-9101 and comprised of a Xenon flashtube and be entirely solid state. The devices shall be UL listed and be capable of either ceiling or wall mounting. Flashing lamp shall be mounted below and connected to the chime unit.

8. Magnetic Door Holder: Magnetic door holders shall be Simplex type 2088-9554 and shall have an approximated holding force of 35 lbs. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Unit shall be semi-flush mounted. Door holders shall be UL Listed for their intended purpose. Mounting height shall be 6'-6" unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall provide and install the system in accordance with the plans and specifications, all national and local applicable codes, NEC wiring criteria, and the manufacturer's recommendations. All communications wiring shall be twisted and shielded cables. All wiring shall be in a conduit system separate from other building wiring. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the scope of work. All junction boxes larger than 4 inches square shall be provided with terminal strips for all wire splices and terminations.
- B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. The manufacturer's authorized representative shall provide all on-site software modifications and supervision of installation of the complete Fire Alarm System installation, perform a complete functional test of the system, and submit a written report to the Contractor attesting to the proper operation of the completed system.

3.2 TESTING

- A. The completed fire alarm system shall be fully tested by the Contractor in the presence of the Owner's representative, the Architect, the Consulting Engineers, the local authority having jurisdiction, and the manufacturer's technical representative. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner, Engineer, and General Contractor.

3.3 WARRANTY

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of 1 year from the date of the completed and certified test. The equipment manufacturer shall make available to the Owner, a maintenance contract proposal to provide a minimum of 2 inspections and tests per year following the criteria of NFPA-72H.

3.4 INSTRUCTION MANUALS

- A. The Contractor shall provide, in addition to one approved copy of the fire alarm system submittal; pertinent system orientation documents, and system service, testing, and alarm documentation in the fire control area for the Owner's and Fire Department's permanent use.

END OF SECTION 16721

SECTION 16880 - SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

1.2 The requirements for Zone 1 seismic protection measures to be applied to electrical equipment specified herein are in addition to any other items called for in other sections of these specifications. The electrical equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

- A. Control Panels
- B. Light Fixtures
- C. Switchboards (Floor Mounted)
- D. Transformers
- E. Conduit 2-1/2" Inside Diameter and Bigger

F. APPLICABLE PUBLICATIONS

1.3 Federal Specifications:

- A. RR-W-410D

1.4 American National Standards Institute, Inc. (ANSI):

- A. B18.2.1-1981
- B. B1B.2.2-1972

1.5 American Society for Testing and Materials (ASTM):

- A. A36-84a
- B. A307-84
- C. A325-85
- D. A501-84
- E. A576-81

PART 2 PRODUCTS

2.1 Sway brace of structural steel conforming with ASTM A36.

2.2 Mechanical couplings of the sleeve type to provide a tight flexible joint under all reasonable conditions.

- 2.3 Underground bolts conforming to ASTM A325.
- 2.4 Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B12.2.2 and ASTM A307 or 306.
- 2.5 Guy wires where required shall conform to Fed Spec. RR-W-441 as follows:
 - 1) 5/32" diameter Type V, Class 1
 - 2) 3/16" to 5/16" diameter Type V, Class 2
 - 3) 1/4" to 5/8" diameter Type I, Class 2

PART 3 EXECUTION

- 3.1 All underground conduit 2" and larger shall have flexible couplings installed adjacent to building. Additional flexible couplings shall be provided as follows:
 - A. On each side of the joints of demarcation between soils having widely differing degrees of consolidation.
 - B. At all points that can be considered to act as anchors.
 - C. All rigidly mounted equipment will have a minimum of 4 anchor bolts securely fastened through bases. Anchor bolts must conform to ASTM A307. Anchor bolts shall have an embedded straight length equal to at least twelve times the nominal diameter of the bolt and shall conform to the applicable tables for various equipment weights.

<u>Maximum Equipment Weight (Pounds)</u>	<u>Zone 1</u>
500	1/2
1,000	1/2
5,000	1/2
10,000	1/2
20,000	1/2
30,000	1/2
50,000	1/2
100,000	1/2

- 1) Based on 4 bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Use equivalent total cross-sectional area when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation

shall be increased in depth to accommodate bolt lengths.

- 2) When height-to-width ratio of the equipment exceed 8.9, overturning must be investigated. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure, except that an equipment weight shall be used. Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.
- 3.2 Equipment Sway Bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree angle from the equipment frame to the building structure secured at both ends with no less than 1/2" bolts. Braces shall conform to all applicable codes and standards for Seismic Zone Classification. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45-degrees, provided that supporting members are properly sized to supporting operating weight of equipment when inclined at a 45-degree angle.
 - 3.3 Lighting fixtures and supports will conform to the following:
 - A. Fixture supports shall be malleable iron.
 - B. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
 - C. Recessed fluorescent individual or continuous-row fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be bolted thereto at each corner of the fixture; or shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures and one wire per unit of continuous row fixtures.
 - D. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting fixtures on 4" boxes, 3" plaster rings, and fixture studs.
 - E. Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissors clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of the structural slab shall be properly anchored to the slab at each corner of the fixture.
 - F. Each wall-mounted emergency light unit shall be secured in a manner to hold the

unit in place during a seismic disturbance.

- 3.4 In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture-supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixtures supports satisfy the requirements given herein.
- A. To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately one cycle per second. The exact number of cycles per second and the actual dimensions of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.07g. The actual fixture-mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions, ranging from parallel to perpendicular to the line of traverse.
 - B. All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1-minute duration with the mounting surface in the line of traverse, at 45-degrees to the line of traverse, and at 90-degrees to the line of traverse. A total of two fixtures shall be tested in each of the above positions. After each of the six tests, the complete stem assemblies from fixtures having stem assemblies shall be subjected to a tensile strength test. The same shall withstand, without failure, a force of not less than four times the weight it is intended to support.
 - C. No component of a fixture nor its supports shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.
 - D. In lieu of the above test requirements, lighting fixtures shall be designed to resist a lateral force of 28 percent of the fixture weight.
- 3.5 Lighting fixture shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:
- A. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendant-hung fixtures not over 20 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws, bolts, or clips.
- 3.6 The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.06 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.
- A. Transformers

B. Switchboards and Switchgear

C. Free Standing Electric Motors

END OF SECTION 16880

SECTION 15000 GENERAL WORK REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. The provisions of General Conditions or any other pertinent documents issued including all parts of the plans and specifications for the entire job, whether attached hereto or not, shall be made a part of this section.

1.2 WORK INCLUDED:

- A. Provide all labor, equipment, appliances, and material in strict accordance with the Project Manual and the applicable drawing. Include all appurtenances necessary for the proper operation of the systems and equipment specified.

1.3 DRAWINGS:

- A. The Mechanical Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. General and Structural Drawings shall take precedence over Mechanical Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, valves and accessories as may be required to meet such conditions.

1.4 CODES AND STANDARDS:

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. Where specific code requirements apply, they shall be included in the job, whether or not specifically shown or elsewhere specified.
- B. In case of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Architect in writing of any such conflicts.
- C. Applicable codes and standards shall include all state laws, local ordinances, utility company regulations, and the applicable requirements of the following adopted codes and standards.

1) Building Codes:

- a) Fire Prevention Code - Arkansas Fire Prevention Code Vol. 1 & 2
- b) Earthquake Code - International Building Code

- c) Plumbing Code - Arkansas State Plumbing Code
 - d) Gas Code - Arkansas State Gas Code
 - e) Mechanical Code - Arkansas Mechanical Code
 - f) Energy Code - Arkansas Rules & Regulations for Energy Efficiency Standards for New Construction
 - g) Electric Code - National Electric Code
 - h) Applicable Local Jurisdictional Requirements & Codes
 - i) International Building Code
- 2) Industry Standards, Codes and Specifications:
- a) AABC - Associated Air Balance Councils
 - b) ANSI - American National Standards Institute
 - c) AMCA - Air Moving & Conditioning Association
 - d) ARI - American Refrigeration Institute
 - e) ASA - American Standards Association
 - f) ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
 - g) ASME - American Society of Mechanical Engineers
 - h) ASTM - American Society of Testing Materials
 - i) AWWA - American Water Works Association
 - j) AWS - American Welding Society
 - k) MSS - Manufacturer's Standardization Society
 - l) NBS - National Bureau of Standards
 - m) NEBB - National Environmental Balancing Bureau
 - n) NFPA - National Fire Protection Association
 - o) SMACNA - Sheet Metal & Air Conditioning Contractors National Association
 - p) UL - Underwriters' Laboratories, Inc.

1.5 FEES, PERMITS AND INSPECTIONS:

- A. The Contractor shall obtain and pay all required fees, permits and inspections of all kind under the section of the specifications for which they are required.
- B. The Contractor shall, upon completion of the work under that section, furnish a certificate of final inspection to the Architect from the inspection department having jurisdiction for each applicable section of the specifications.

1.6 CHARTS, DIAGRAMS AND SCHEMES:

- A. Charts, diagrams and schemes listed below shall be provided by the Contractor. The number, arrangement and details of construction shall be approved by the Architect.
- B. Lubrication charts shall list all types of lubricant for each piece of equipment, and recommended frequency of lubrication.
- C. Valve tag schedule shall list all isolation and control valves by system. Scheme shall be an extension of the Owner's existing system.
- D. Filter schedules shall list all filters required by each piece of equipment as well as the total requirement for each filter model and size.
- E. Automatic Temperature Control Diagrams, including a detailed sequence of operation, referencing each control device for each function.
- F. Test and Balance Reports per section 15990 of the specifications.

1.7 INSPECTION OF PREMISES:

- A. Before submitting a proposal on this work, the Contractor visit the site of the proposed work and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.8 SUBMITTAL ADMINISTRATIVE REQUIREMENTS:

- A. General Submittal Procedure Requirements:
 - 1) Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - a) Submit submittals to Architect.'
 - b) Architect will return annotated file.
 - 2) Digital Data Files:

- a) Electronic data files of the Project drawings may be provided by Engineer for Contractor's use in preparing submittals.
 - b) Cost to the Contractor shall be \$50 for AutoCAD drawings or \$100 for Revit models (if available).
 - c) Electronic digital data files supplied for use in submittal preparation will be subject to terms and conditions of the Engineer's Release Form.
 - d) A signed release form and payment must be returned to the Engineer prior to the transmission of any electronic digital data files.
- 3) Coordination:
- a) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - b) Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - c) Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - d) Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - e) Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- 4) Processing Time:
- a) Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - b) Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 - c) Resubmittal Review: Allow 14 days for review of each resubmittal.
- 5) Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

- a) Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
- b) Name file with submittal number or other unique identifier, including revision identifier.
- c) Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
- d) Transmittal Form for Electronic Submittals: Use electronic form containing the following information:
 - i. Project name.
 - ii. Date.
 - iii. Name and address of Engineer.
 - iv. Name of Construction Manager.
 - v. Name of Contractor.
 - vi. Name of firm or entity that prepared submittal.
 - vii. Names of subcontractor, manufacturer, and supplier.
 - viii. Category and type of submittal.
 - ix. Submittal purpose and description.
 - x. Specification Section number and title.
 - xi. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - xii. Drawing number and detail references, as appropriate.
 - xiii. Location(s) where product is to be installed, as appropriate.
 - xiv. Related physical samples submitted directly.
 - xv. Indication of full or partial submittal.
 - xvi. Transmittal number.
 - xvii. Submittal and transmittal distribution record.
 - xviii. Other necessary identification.
 - xix. Remarks.

- 6) Options:
 - a) Identify options requiring selection by Engineer.
- 7) Deviations and Additional Information:
 - a) On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- 8) Resubmittals:
 - a) Make resubmittals in same form and number of copies as initial submittal.
 - b) Note date and content of previous submittal.
 - c) Note date and content of revision in label or title block and clearly indicate extent of revision.
 - d) Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- 9) Distribution:
 - a) Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- 10) Use for Construction:
 - a) Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.
- 11) Comparable Product Requests:
 - a) Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - b) Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - c) Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 14

days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- i. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.9 CLOSEOUT SUBMITTALS

- A. Closeout submittals shall include, but not limited to, the following:

- 1) Operation and Maintenance Materials
- 2) Record Drawings
- 3) Demonstration and Training Materials
- 4) Final Approved Submittals

1.10 INSTRUCTIONS OF OWNER'S REPRESENTATIVE:

- A. The Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical and electrical systems. A competent representative of the Contractor shall spend sufficient time in such formal instruction to fully prepare the Owner to operate and maintain the Mechanical Systems.

1.11 GUARANTEE:

- A. The Contractor shall furnish a written certificate, guarantying all materials, equipment, and labor furnished to be free of all defects for a period of one year from the date of final acceptance of the work by the Architect. The Contractor shall further guarantee that if any defects appear within the stipulated guaranty period, such work shall be replaced without charges.

1.12 EXTENDED WARRANTIES:

- A. Some items of specific equipment are specified to be furnished with extended warranties. The extension of time specified for these warranties shall commence or initiate one (1) year after the final acceptance by the Architect.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 5) Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

- 6) Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 7) Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 8) Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
- 1) Store products to allow for inspection and measurement of quantity or counting of units.
 - 2) Store materials in a manner that will not endanger Project structure.
 - 3) Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation or moisture damage.
 - 4) Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5) Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6) Protect stored products from damage and liquids from freezing.
 - 7) Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.14 DEFINITIONS:

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, 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 duct shafts.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

- 1) Submit electronic submittals to Engineer.
 - a) Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
- 2) Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - a) If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - b) Mark each copy of each submittal to show which products and options are applicable.
 - c) Include the following information, as applicable:
 - i. Manufacturer's catalog cuts.
 - ii. Manufacturer's product specifications.
 - iii. Standard color charts.
 - iv. Statement of compliance with specified referenced standards.
 - v. Testing by recognized testing agency.
 - vi. Application of testing agency labels and seals.
 - vii. Notation of coordination requirements.
 - viii. Availability and delivery time information.
 - d) For equipment, include the following in addition to the above, as applicable:
 - i. Wiring diagrams showing factory-installed wiring.

- ii. Printed performance curves.
 - iii. Operational range diagrams.
 - iv. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 3) Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
 - 4) Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."
 - 5) Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."
 - 6) Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
 - 7) Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

2.2 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1) Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2) Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3) Were two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 - 4) Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 5) Where products are accompanied by the term "as selected," Engineer will make selection.
 - 6) Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

- 7) Products containing asbestos shall not be used.
- 8) Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

2.3 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 - B. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - C. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - D. Evidence that proposed product provides specified warranty.
 - E. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - F. Contractor is responsible for any modification required by products other than the basis of design product at no additional cost to the owner including but not limited to modifications to supports and connections.

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION:

- A. Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated on the drawings. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
- B. Furnish engraved plastic laminate signs on all panels and equipment:
 - 1) Signs shall be constructed of ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
 - 2) Fabricate in sizes required for message. Provide holes for mechanical fastening. Engraving shall be engraver's standard letter style, of sizes and with terms to match equipment identification. Thickness shall be 1/8 inch for units up to 20 square inches or 8 inches in length.

- 3) Fasteners shall be self-tapping, stainless steel screws or contact-type, permanent adhesive.
- C. Control Items: Label all thermostats.
- D. Valve Tags:
 - 1) Provide for all HVAC valves.
 - 2) Furnish and install valve tags with engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.

2.5 EQUIPMENT AND MATERIALS:

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- D. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
- F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.
- G. It shall be the responsibility of the Contractor to ensure that furnished items fit the space available. The Contractor shall make necessary field measurements

to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.

- H. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

2.6 EQUIPMENT ACCESSORIES:

- A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.
- B. Connections: All piping connecting to equipment shall be installed without strain at the piping connection.
- C. Connections Different From Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, ductwork, supports, insulation, etc. The Contractor shall provide any additional valves, fittings, and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

2.7 ELECTRIC MOTORS:

- A. Refer to Division 16 for applicable requirements for electric motors.
- B. This Contractor shall furnish electric motors with full load efficiencies not less than the values scheduled on the drawings.

PART 3 - EXECUTION

3.1 COORDINATION OF WORK:

- A. The Contractor shall compare the Mechanical Drawings and Specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the Mechanical Work. The Mechanical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences.

All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.

- B. Anchor bolts, sleeves, inserts and supports that may be required for the Mechanical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also ensure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of pipes, ducts, equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication.
 - 1) Right-of-Way: Lines which pitch shall have the right of way over those which do not pitch. For example: plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
 - 2) Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to affect these offsets, transitions and changes in direction.
- E. Installation and Arrangement:
 - 1) The Contractor shall install all Mechanical Work to permit removal (without damage to other parts) of coils, fans, filters, and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts and equipment to permit ready access to valves, cocks, control components and to clear the openings of swinging and overhead doors and of access panels.
- F. Ductwork:

- 1) The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Architect prior to fabrication of ductwork requiring such changes.

G. Coordination Drawings:

- 1) The Contractor shall furnish detailed coordination drawings for all congested areas including but not limited to Mechanical Rooms, and space restricted ceiling cavities. Coordination drawings shall indicate room dimensions, support column locations, and space requirements for installation and access. Include the following:
 - a) Planned piping layout, including valve and specialty locations and trench locations.
 - b) Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - c) Equipment and accessory locations, service connections, and support details.
 - d) Exterior wall and foundation penetrations and sleeve locations.
 - e) Sizes and location of required concrete pads and bases.
 - f) Floor plans, elevations, and details to indicate penetrations in floors, walls, and roofs and their relationship to other penetrations and installations.
 - g) Layout shall include all other trades impacting the mechanical work such as electrical equipment.

H. Access:

- 1) The Contractor shall provide all necessary access panels in walls, ceilings, equipment, ducts, etc., as required for inspection of interiors and for proper maintenance and or installation of equipment valves and dampers. Where changes from the plans are made by the Contractor in the installation of his work, he shall provide any and all access panels required as a result of these changes.

I. Drawings by Contractor:

- 1) When directed by the Architect, the Contractor shall submit for approval by the Architect drawings clearly showing the Mechanical Work and its relation

to the work of other trades before commencing shop fabrication or erection in the field.

3.2 AS-BUILT DRAWINGS:

- A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the Drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job. Exact location of all piping and utility service entrances and their connections to utility mains as well as all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Owner one (1) set of "As-Built" reproducibles legibly and accurately marked to indicate all changes, additions, deletions, etc., from the Contract Drawings.

3.3 CUTTING AND PATCHING:

- A. Under each section of the specifications, the Contractor shall be responsible for all required cutting, etc., incident to his work under that section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any structural element, beam or column without explicit instructions from the Architect.
- B. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades because of his fault, error or tardiness or because of any damage done by him.

3.4 EXCAVATION AND TRENCHING FOR PIPING:

- A. The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings, or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other methods. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe or duct can be safely and properly installed and backfill can be properly tamped in such tunnel sections. The Contractor shall be responsible for shoring all trenches in accordance with industry standards and local codes. The Contractor shall be liable for the safety of the workmen in the trench and observe safety rules at all times.
- B. Trench Excavation:
 - a) Trenches shall be of necessity width for the proper laying of the piping, and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point

along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum overdepth of 4" below the trench depths indicated on the drawings or specified. Overdepths in the rock excavation and unauthorized overdepths shall be backfilled with loose, granular, moist earth, thoroughly tamped. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel or other suitable material, as hereinafter specified.

C. Depth of Cover:

- a) Trenches for utilities shall be of a depth that will provide the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

- i. Two (2) feet - six (6) inches minimum cover: Natural gas.

D. Excavations for Appurtenances:

- a) Excavation for manholes and similar structures shall be sufficient to level at least 12" in the clear between their outer surfaces and the embankment or timbers which may be used to hold and protect the banks. Any overdepth excavation below such appurtenances shall be considered as unauthorized and shall be filled with sand, gravel, or concrete at the expense of the Contractor.

E. Protection of Existing Utilities:

- a) Existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

F. No blasting will be allowed.

3.5 BACKFILLING OF TRENCHES:

- A. Trenches shall not be backfilled until all required pressure and other tests have been performed, witnessed by the Architect, and until the utilities systems as installed confirm to the requirements of the drawings and specifications.

B. Normal Backfill:

- a) Where compacted backfill is not specified the trenches shall be carefully backfilled with the materials approved for backfilling (See appropriate section), deposited in 6" layers and thoroughly and carefully rammed until the pipe has a cover of not less than one foot. The remainder of the backfill material shall then be carefully placed in the trench in one (1) foot layers and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition.
- C. Compacted backfill shall be used under slabs on grade, building structure, concrete paving and asphaltic concrete paving. The soils used in the fill shall be granular in nature and shall not contain roots, sod, rubbish or stones over 1-1/2" maximum dimension.
- a) Required Density:
 - i. All fills shall be compacted to a dry density equal to at least 90 % of the maximum density determined in accordance with the Modified AASHO Method of Compaction. The maximum density and optimum moisture content shall be determined on the basis of laboratory tests conducted on the materials used in the fill.
 - ii. Modified AASHO Compaction Method provides that soil samples be compacted in five (5) equal layers in a standard compaction cylinder having a volume of 1/30 cu. ft. using twenty-five (25) 18" blows of 10 pound rammer to compact each layer.
 - b) Control Tests:
 - i. Adequacy of compaction shall be determined on the basis of in-place density determinations that are to be conducted while the fills are being placed. The results of these tests shall be the basis on which satisfactory completion of the work is judged. Should the fills fail to meet the specified densities, the Contractor shall remove and recompact the soils until the specified densities are achieved.
 - c) Equipment:
 - i. The choice of compaction equipment shall be made by the Contractor; however, the equipment shall be adequate for achieving the specified densities. Use of hand-operated, power-driven compaction equipment may be necessary at locations inaccessible to roller-type equipment.

3.6 CONSTRUCTION PHASING:

- A. The Contractor shall refer to the General Requirements of this specification and prepare all work schedules required to perform all work as shown on the Drawings and as herein specified.

3.7 INTERRUPTION OF SERVICES:

- A. The progress of the job will require interruption of certain services in order to make connections and change over to new systems, including routing piping, ductwork, etc. through occupied areas. In general, this type of work shall be done late at night (after 10:00 p.m.), weekends (day or night) or early in the morning (before 6:00 a.m.) or as described in the phasing plan or schedule. The Contractor shall visit the job site to determine extent of interruptions required by herein specified work. Requests for interruptions shall be made one week prior to planned shutdown, and must be coordinated with the Architect, Engineer, and Owners' Representative. No interruption will be allowed without written approval from the Owner. The cost of interruptions shall be a part of the Contract Amount. No additional cost to the Owner will be allowed for interruptions, no matter how many are required.
- B. Any accidental disturbance of service as a result of this Contract will be immediately restored at no additional cost to the Owner.
- C. If service changes require temporary connections, the Contractor will make all necessary arrangements for such temporary connections and furnish the required materials and labor at no additional cost to the Owner.

3.8 PAINTING:

- A. The Contractor shall remove all rust, oil and grease from exposed surfaces and clean all apparatus or materials specified to be painted under this section of the specifications. Contractor shall paint equipment, piping, etc., in accordance with Division 9. Equipment specified to have factory finishes shall be protected until completion of the Contract, with Contractor being responsible for maintaining finishes.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - a) Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - b) Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over galvanized metal primer.
 - c) Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - d) Exterior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over rust-inhibitive metal primer.
 - e) Exterior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over galvanized metal primer.

- f) Exterior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include two (2) finish coats over rust-inhibitive metal primer.

- C. Do not paint piping specialties with factory-applied finish.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- E. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

3.9 LUBRICATION:

- A. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated up to the date of acceptance of the equipment. The Contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. Fan shafts, motor shafts, etc. shall be coated to prevent deterioration in moist or wet atmospheres.

3.10 ELECTRICAL WORK:

- A. All power and motor wiring shall be done by the Electrical Contractor unless otherwise noted for specific items. Control and interlock wiring shall be done by the Mechanical Contractor.
- B. The Mechanical Contractor shall furnish and install any low voltage relays, pressure switches, thermostats and similar items required for the proper operation of the mechanical equipment.
- C. The Electrical Contractor shall furnish all motor starters and drives unless included in other sections of the specifications. Furnish auxiliary contacts on magnetic starters to permit interlocking of starting circuits.

3.11 ELECTRIC MOTORS:

- A. Refer to Division 16 for applicable requirements for electric motors.
- B. Furnish and install electric motors with energy efficiencies not less than the values scheduled on the drawings.

3.12 SWITCHGEAR DRIP PROTECTION:

- A. Every effort shall be made to eliminate the installation of pipe above electrical, telephone and data equipment. If this is not possible, the Contractor shall notify the Architect before proceeding with installation. Upon approval by the Architect, the Contractor shall encase the pipe in a second pipe with a minimum number of

joints. Provide 18 gauge (minimum) galvanized, four inch (minimum) deep drain pans under existing piping located or passing over electrical switchgear or distribution panels. Pipe 1" drain from pan to nearest floor drain. Drain pan shall be adequately supported and constructed to hold four inches of water without collapse.

3.13 EQUIPMENT START-UP AND TESTING:

- A. The Contractor shall instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment, including pumps and boilers. During the operating tests, the Contractor shall provide the operation of each item of equipment. At least seven (7) days' notice shall be given to the Architect of equipment start-up and operating tests.

3.14 INACCESSIBLE EQUIPMENT:

- A. Where the Architect or Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action (such as providing access panels) performed as directed at no additional cost to the Owner.
- B. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.15 DEMOLITION:

- A. Disconnect, demolish, and remove Work specified in Division 15 Sections.
- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of two (2) inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.

- 3.16 SALVAGE: The Owner shall have the first right of refusal of all equipment and materials being removed. The Contractor shall coordinate with the Owner, before demolition begins, to determine which equipment and materials will be retained by the Owner. The Contractor shall remove and transport said equipment and materials to storage facilities on site, as directed by the Owner. All other material being removed shall be disposed of in a legal landfill by the Contractor. The Contractor shall be responsible for all costs incurred in transporting and disposing of salvage materials.

END OF SECTION 15000

SECTION 15060 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The provisions of General Conditions or any other pertinent documents issued including all parts of the plans and specifications for the entire job, whether attached hereto or not, shall be made a part of this section.

1.2 DESCRIPTION

- A. Provide pipe, pipe fittings and related items required for complete piping system.

1.3 RELATED WORK:

- A. Section 15000 - Basic Mechanical Requirements
- B. Section 15090 - Mechanical Supporting Systems
- C. Section 15120 - Valves
- D. Section 15190 - Mechanical Identification
- E. Section 15401 - Domestic Water System
- F. Section 15405 - Drainage, Sanitary Waste & Vent System

1.4 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacturer of pipe, tube, and fittings of types and sizes required, whose products have been in satisfactory use in similar service.
- B. Welding: Qualify welding procedures, welders and operators in accordance with ANSI B31.1, paragraph 127.5, for shop and project site welding of piping work.
- C. Brazing: Certify brazing procedures, brazers, and operators in accordance with ANSI B31.5, paragraph 527.5 for shop and job-site brazing of piping work.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Provide factory-applied plastic and end-caps on each length of pipe and tube intended for clean use. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.6 SEQUENCING AND SCHEDULING:

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical 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 connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- D. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 NOISE CONTROL:

- A. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise. Where excessive noise is generated in a piping system, due to arrangement or velocity of the fluid within the pipe, the contractor shall make modifications as required or as directed by the Engineer, to reduce noise to an acceptable level.

1.8 CROSS-CONNECTIONS:

- A. No piping shall be installed which will provide a cross-connection between potable water system and a polluted supply.

1.9 PIPE IDENTIFICATION:

- A. A stenciled legend identifying the gas or fluid conveyed and direction of flow shall be indicated on all piping by the trade furnishing and installing the pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts,

tunnels, and plenums; and exterior non-concealed locations according to the following:

1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 3. Near penetrations through walls, floors, ceilings, or non-accessible 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 a maximum of 20-foot intervals along each run.
 7. On piping above removable acoustical ceilings.
- C. Identification and symbols shall comply with latest edition of ANSI A.13.1. Letters shall be sized in accordance with the following:

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	HEIGHT OF LEGEND LETTERS
Up to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/2"
Over 6"	24"	2-1/2"

PART 2 - PRODUCTS

2.01 PIPING MATERIALS:

- A. Steel Pipe:
1. Black steel ANSI / ASTM A 53, Grade "B", seamless or ERW (2" and larger).
 2. Black steel ANSI / ASTM A 53, Grade "F", continuous weld (1/2" up to 2").

3. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedules 40 and 80, carbon steel, seamless for 2-inch NPS and smaller and electric-resistance welded for 2-1/2-inch NPS and larger.

B. Copper Tube:

1. Copper Tube: ANSI / ASTM B 88; Type as indicated for each service; hard drawn above grade and soft drawn below grade.
2. DWV Copper Tube: ANSI / ASTM B 306.

C. Polyvinyl Chloride Pipe:

1. Gravity Sewer Pipe: Hub And Spigot; ASTM D-2665 drain waste and vent Schedule 40 PVC.
2. Pressure Pipe:
 - a. AWWA C900, Class 150; ASTM D-1509, ASTM D-1869. ASTM D - 2241 and ASTM D-2444.
 - b. Schedule 40 PVC / CPVC or Schedule 80 PVC / CPVC; ASTM D-1784, ASTM D-1785 and ASTM F - 441.

2.02 FITTING MATERIALS:

A. Fittings for Steel Pipe:

1. Malleable Iron Threaded Fittings: ANSI B16.3
2. Malleable Iron Threaded Unions: ANSI B16.39
3. Malleable Iron Threaded Flanges: ANSI B16.3, ASTM A197
4. Butt-Weld Steel Fittings: ANSI B16.9, ASTM A 234. All ells shall be long radius.
5. Pipe Flanges and Flanged Fittings: ANSI B16.5
6. Socket Welded or Threaded Fittings: ANSI B16.11
7. Stainless Steel Butt-Weld Steel Fittings: ANSI B16.9 Subclass WP-W, ASTM A 403

B. Fittings for Copper Pipe:

1. Cast Brass Solder Joint Fittings: ANSI B16.18
2. Cast Copper Alloy Solder Joint Drainage Fittings: ANSI B16.23

3. Cast Brass Flared Tube Fittings: ANSI B16.26
4. Wrought Copper Solder Joint Fittings: ANSI B16.22
5. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29
6. Non-Ferrous Pipe Flanges: ANSI B16.31
7. Flared Copper Fittings: SAE J513 and ANSI B70.1

C. Fittings for Cast Iron Pipe:

1. Hubless Cast-Iron Soil Pipe Fittings: CISPI 301
2. Cast Iron Hub and Spigot Soil Pipe Fittings: ASTM A-74 and ANSI A-112.5-1
3. Double Seal Compression Type Gaskets: ASTM C-564

D. Fittings For Polyvinyl Chloride Pipe:

1. Gravity Sewer Pipe: Hub and Spigot; ASTM D-3034 Schedule 40 drain, waste and vent. Joints: ASTM D-3212.
2. Pressure Pipe Fittings:
 - a. Gray iron Class 150 ANSI / AWWA C110 / A.21.1; Cement-Mortar Lining for Ductile Iron Pipe and Fittings: ANSI / AWWA C104 / A.21.4. Minimum thickness shall be Class 50, unless otherwise noted. Mechanical joints: ANSI / AWWA C111 / A 21.11.
 - b. Schedule 40 PVC / CPVC pressure rated socket type, ASTM D-2466 or F-438.
 - c. Schedule 80 PVC / CPVC pressure rated type, ASTM D-2467 or F-439.

2.03 PIPE AND FITTINGS:

- A. Condensate, Equipment, and Relief Drains: One and one-fourth (1-1/4) inch or larger drains shall be DWV copper. One (1) inch and smaller drains shall be Type "M" copper. Fittings shall be cast brass drainage fittings or wrought copper (one (1) inch and smaller). Joints shall be made with Stay Safe "Bridgit" Lead Free Solder, or equal.
- B. Domestic Hot and Cold Water Piping:
 1. All other cold and hot water piping within the building unless noted otherwise shall be Type "L" hard drawn copper tubing, with solder joint wrought copper tube fittings. Joints shall be made with Stay

Safe "Bridgit" Lead Free Solder, or equal. Lead solder shall NOT be used on any system.

2. Adaptors shall be used for screwed valves in copper piping. Connections between copper and steel shall be insulated to prevent electrolysis. All water piping shall pitch to low point to drain.

C. Water and Sewer Mains:

1. Exterior fire protection service line shall be ductile iron with push-on joints. Fittings shall be cast iron with mechanical joint.
2. Hot and cold water piping, including water service, which is run in or under the building, shall be Type "K" hard drawn copper tubing. Joints shall be made with 15 % silver solder. Cold water piping 4" and larger, including water service, which is run underground (outside the building footprint), may be ductile iron piping.
3. Exterior sewer main shall be cast iron single hub pipe with hub and spigot fittings up to initial manhole connection. Refer to site plan for continuation. Hub gaskets shall be equal to Tyler Pipe "Ty-seal".
4. Exterior storm drain shall be Schedule 35 PVC with push on joints.

D. Fire Protection Piping: Refer to Section 15500.

E. Sanitary Sewer, Storm Sewer, and Vent Piping:

1. Waste arms for lavatories and sinks shall be DWV copper with cast brass adaptors and wrought copper fittings. All interior sanitary sewer, vent, and storm drain piping above grade shall be standard weight cast iron soil pipe and with no-hub fittings, unless noted otherwise. Sanitary sewer, vent and storm drain piping below grade shall be standard weight cast iron soil pipe with hub and spigot fittings. Hub gaskets shall be equal to Tyler Pipe's "Ty-seal".
2. Piping must be of sizes noted and run as indicated on the drawings, and shall be given a uniform grade of 1/4" per foot wherever possible, but in no case less than 1/8" per foot, unless otherwise noted on plans. The soil and waste vent piping shall be extended through roof. Each riser extending through roof shall project 10" above roof lines and shall be thoroughly flashed as detailed on drawings.

F. Couplings and Nipples:

1. Couplings shall have an iron-body sleeve assembly, fabricated to match outside diameter of plain-end, pressure pipes, with an ASTM A 126, Class B, gray iron sleeve. Followers shall be constructed of ASTM A 47 malleable iron or ASTM A 536 ductile iron. Gaskets

shall be constructed of rubber and bolts and nuts shall comply with AWWA C111.

2. Dielectric couplings shall be galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
3. Dielectric nipples shall be electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

G. Unions:

1. All union connections in copper piping shall be ground joint brass unions, having brass taper seat and both screw ends hexagonal and shall be designed for a steam working pressure up to 125 pounds.
2. Union connections in steel piping shall be heavy pattern ground joint malleable unions of same finish as pipe, having brass taper seat and hexagonal screw ends and shall meet same pressure ratings as fittings for that particular piping system. Union connections of similar piping 2-1/2" and larger shall be made with malleable iron gasketed type flanged unions, meeting same pressure ratings as fittings for that particular piping system.
3. Dielectric unions complying with ANSI B16.39 or insulating flange gasket and bolt sleeves complying with ANSI B16.42 shall be installed where jointing occurs of two (2) dissimilar metal pipes.

H. Pipe Joints:

1. Threaded Joints:
 - a. 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 inner diameter. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - b. Join pipe fittings and valves as follows:
 1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 3. Align threads at point of assembly.

4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 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.
2. Brazed Joints:
 - a. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube".
 3. Soldered Joints:
 - a. Joints in copper pipe shall be sanded and lead free solder used on fittings and joints. Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook".
 4. Welded Joints:
 - a. Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 5. Flanged Joints:
 - a. Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
 - b. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 6. Plastic Piping Solvent-Cement Joints
 - a. Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
- I. Pipe Flanges:
 1. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full face neoprene gasket suitable for 220 degrees F complying with ASME B16.21. At the Contractor's option, convoluted, cold formed

150 pound steel flanges, with teflon gaskets, may be used for water service.

2. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
 3. Where ferrous flanges are connected to non-ferrous flanges, install dielectric insulating flange gasket and bolt sleeve kits. Components shall include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- J. Mechanical Pipe Couplings and Fittings may be used where specifically noted with cut or roll grooved pipe, in water service up to 230 degrees F in lieu of welded, screwed or flanged connections.
1. Grooved Mechanical Couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two (2) or more parts, securely held together by two (2) or more track-head, square, or oval-neck bolts, ASTM A183.
 2. Gaskets: Synthetic rubber product recommended by the coupling manufacturer for the intended service.
 3. Grooved End Fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Piping shall be properly supported and adequate provisions shall be made for expansion, contraction, slope, and anchors. High points of all water piping and where flow in pipe turns down shall be vented by means of extending vent pipe, with terminal 1/4" globe valve to an accessible position 6 ft. above floor in mechanical rooms.
- B. All piping shall be cut accurately for fabrication to measurements established at the construction site.
- C. Pipe shall be worked into place without springs and / or forcing, properly clearing all windows, doors and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will NOT be permitted.
- D. All pipes shall have burr and cutting slag removed by reaming or other cleaning methods.
- E. All changes in direction shall be made with fittings; bending of pipe will not be permitted.

- F. Trench Indicators: Furnish in all exterior pipe trenches, color coded vinyl detector tape with metallic facing.
- G. Copper pipe routed below grade under concrete or fill which may attack the pipe surface shall be sleeved with a 4 mil thickness polyethylene sleeve, equal to Oatey's Pipe Guard". Hot water lines shall have a red sleeved and cold water shall be installed in a blue sleeve.

3.02 ARRANGEMENT:

- A. All piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes, or other access openings.
- B. Unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment valves on special fittings. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc.
- C. Flanges, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment valves on special fittings. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc.
- D. When horizontal lines are reduced in size (in the direction of flow), eccentric reducing fittings shall be used. Eccentric fittings shall be installed with the "flat" on top for fluids and the "flat" on bottom for vapors; steam, compressed air, refrigerant, etc. When horizontal lines are increased in size (in the direction of flow), concentric reducing fittings shall be used. No bushings will be permitted.

3.03 TESTING:

- A. Test all piping systems provided under this contract and obtain approval from the Architect before acceptance. Testing shall be done before piping is concealed or connected to equipment or outlets.
- B. The Contractor shall record the ambient temperature and the gas or fluid temperature within the piping prior to testing. The Contractor shall not test piping at pressures exceeding the manufacturer's published ratings for the job site conditions. In the event of a contradiction between the manufacturer's testing recommendations and the instructions listed below, the Contractor shall notify the Engineer in writing of such discrepancy and suspend testing until receiving further instruction from the Engineer.
- C. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
- D. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing

against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.

- E. Install relief valve set at a pressure no more than one-third (1/3) higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- F. Testing Requirements:
 - 1. Sanitary Sewer: Test with water to a head of 10 ft. for 1 hour.
 - 2. Domestic Water: Test with nitrogen at 100 psig for 24 hours.
 - 3. HVAC Piping: Test with nitrogen at 100 psig for 24 hours.

END OF SECTION 15060

SECTION 15061 FACILITY NATURAL GAS PIPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.2 RELATED REQUIREMENTS

- A. Section 08 3100 - access doors and panels.
 - 1) Section 09 9113 - exterior painting.
 - 2) Section 09 9123 - interior painting.
 - 3) Section 22 0516 - expansion fittings and loops for plumbing piping.
 - 4) Section 22 0548 - vibration and seismic controls for plumbing piping and equipment.
 - 5) Section 22 0719 - plumbing piping insulation.
 - 6) Section 31 2316 - excavation.
 - 7) Section 31 2323 - fill.
 - 8) Section 33 5216 - gas hydrocarbon piping.

1.3 REFERENCE STANDARDS

- 1) Ansi z21.18/csa 6.3 - gas appliance pressure regulators 2019.
- 2) Ansi z21.80/csa 6.22 - line pressure regulators 2011 (addendum a, 2012).
- 3) Ansi z223.1 - national fuel gas code 2016.
- 4) Asme bpvc-ix - qualification standard for welding, brazing, and fusing procedures; welders; brazers; and welding, brazing, and fusing operators - welding brazing and fusing qualifications 2019.
- 5) Asme b16.3 - malleable iron threaded fittings: classes 150 and 300 2016.
- 6) Asme b31.1 - power piping 2018.
- 7) Astm a53/a53m - standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless 2018.
- 8) Astm a234/a234m - standard specification for piping fittings of wrought carbon steel and alloy steel for moderate and high temperature service 2019.
- 9) Astm b813 - standard specification for liquid and paste fluxes for soldering of copper and copper alloy tube 2016.
- 10) Astm b828 - standard practice for making capillary joints by soldering of copper and copper alloy tube and fittings 2016.
- 11) Awwa c105/a21.5 - polyethylene encasement for ductile-iron pipe systems 2010.
- 12) lcc-es ac193 - acceptance criteria for mechanical anchors in concrete elements 2015.
- 13) lcc-es ac308 - acceptance criteria for post-installed adhesive anchors in concrete elements 2016.

14) Mss sp-78 - cast iron plug valves, flanged and threaded ends 2011.

15) Mss sp-110 - ball valves threaded, socket-welding, solder joint, grooved and flared ends 2010.

1.4 SUBMITTALS

- A. SEE SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS, FOR SUBMITTAL PROCEDURES.
- B. Product data: provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welder certificate: include welders certification of compliance with asme bpvc-ix.
- D. Project record documents: record actual locations of valves.
- E. Maintenance materials: furnish the following for owner's use in maintenance of project.
- F. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 – PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
 - 1) Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2) Joints: ANSI Z223.1, welded.

- 3) Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - B. NATURAL GAS PIPING, ABOVE GRADE
 - C. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
 - 1) Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2) Joints: Threaded or welded to ASME B31.1.
- 2.2 FLANGES, UNIONS, AND COUPLINGS
- A. Unions for Pipe Sizes 3 Inches and Under:
 - 1) Ferrous Pipe: Class 150 malleable iron threaded unions.
 - B. Flanges for Pipe Size Over 1 Inch:
 - 1) Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
- 2.3 PIPE HANGERS AND SUPPORTS
- A. Provide hangers and supports that comply with MSS SP-58.
 - 1) If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2) Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3) Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4) Vertical Pipe Support: Steel riser clamp.
 - 5) Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
 - B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1) Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2) Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 3) Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
- 2.4 BALL VALVES
- A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.
- 2.5 PLUG VALVES
- A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.
- 2.6 STRAINERS

- A. Size 2 inch and Under:
 - 1) Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - 2) Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - B. Size 1-1/2 inch to 4 inch:
 - 1) Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- 2.7 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS
- A. Compliance Requirements:
 - 1) Appliance Regulator: ANSI Z21.18/CSA 6.3.
 - 2) Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
 - B. Materials in Contact With Gas:
 - 1) Housing: Aluminum, steel (free of non-ferrous metals).
 - 2) Seals and Diaphragms: NBR-based rubber.
 - C. Maximum Inlet Operating Pressure: 10 psi.
 - 1) Appliance Regulator: 10 psi.
 - 2) Line Pressure Regulator: 10 psi.
 - D. Maximum Body Pressure: 10 psi.
 - E. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - 1) Refer to Section 22 0719.
- H. Provide access where valves and fittings are not exposed.
 - 1) Coordinate size and location of access doors with Section 08 3100.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
 - 1) Painting of interior piping systems and components is specified in Section 09 9123.
 - 2) Painting of exterior piping systems and components is specified in Section 09 9113.
- L. Excavate in accordance with Section 31 2316.
- M. Backfill in accordance with Section 31 2323.
- N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- P. Sleeve pipes passing through partitions, walls and floors.
- Q. Inserts:
 - 1) Provide inserts for placement in concrete formwork.
- R. Pipe Hangers and Supports:
 - 1) Support horizontal piping as indicated.
 - 2) Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3) Place hangers within 12 inches of each horizontal elbow.
 - 4) Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5) Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 6) Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

- a) Painting of interior piping systems and components is specified in Section 09 9123.
 - b) Painting of exterior piping systems and components is specified in Section 09 9113.
- 7) Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.
- E. Provide plug valves in natural gas systems for shut-off service.

3.5 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators in accordance with Section 33 5216. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.6 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1) Metal Piping:
 - a) Pipe Size: 1/2 inches to 1-1/4 inches:
 - i. Maximum Hanger Spacing: 6.5 ft.
 - ii. Hanger Rod Diameter: 3/8 inches.
 - b) Pipe Size: 1-1/2 inches to 2 inches:
 - i. Maximum Hanger Spacing: 10 ft.
 - ii. Hanger Rod Diameter: 3/8 inch.

END OF SECTION 15061

SECTION 15062 REFRIGERANT PIPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.
- N. Engineered wall seals and insulation protection.
- O. Exterior penetration accessories.

1.2 RELATED REQUIREMENTS

- A. Section 23 0719 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers 2005.
- B. AHRI 710 - Performance Rating of Liquid-Line Driers 2009.
- C. AHRI 750 - Thermostatic Refrigerant Expansion Valves 2007.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants 2019.
- E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants 2019.
- F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2019.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

- K. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service 2020.
- L. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011 (Amended 2012).
- M. ICC (IMC)-2018 - International Mechanical Code 2018.
- N. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 – PRODUCTS

2.1 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
- B. Fittings: ASME B16.22 wrought copper.
- C. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- D. Mechanical Press Sealed Fittings: Double pressed type complying with UL 207 and ICC (IMC)-2018.
- E. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
- F. Fittings: ASME B16.26 cast copper.
- G. Joints: Flared.

2.2 REFRIGERANT

- A. Refrigerant: R410-A as defined in ASHRAE Std 34.

2.3 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.4 VALVES

- A. Diaphragm Packless Valves:
 - 1) UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 - 1) Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Ball Valves:

- 1) Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:

- 1) Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.5 STRAINERS

A. Straight Line or Angle Line Type:

- 1) Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.6 CHECK VALVES

A. Globe Type:

- 1) Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

B. Straight Through Type:

- 1) Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.7 PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.8 PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.9 FILTER-DRIERS

A. Performance:

- 1) Flow Capacity - Liquid Line: minimum, rated in accordance with AHRI 710.
- 2) Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
- 3) Design Working Pressure: 350 psi, minimum.

- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.

- 1) Connections: As specified for applicable pipe type.

2.10 EXPANSION VALVES

- A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.11 RECEIVERS

- A. Internal Diameter Over 6 inch:
 - 1) AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.12 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

END OF SECTION 15062

SECTION 15073 – SEISMIC / VIBRATION ISOLATION FOR MECHANICAL
COMPONENTS

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Intent:

1. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
5. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements
6. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
7. Seismic restraints shall be designed in accordance with seismic force levels as detailed in section 1.06.

B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Equipment isolation bases.
3. Flexible piping connections.
4. Seismic restraints for isolated equipment.

5. Seismic restraints for non-isolated equipment.
6. Certification of seismic restraint designs and installation supervision.
7. Certification of seismic attachment of housekeeping pads.
8. All mechanical and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).
 - a. Air Handling Units
 - b. Condensing Units
 - c. Cooling Towers
 - d. Ductwork
 - e. Fans (all types)
 - f. Piping
 - g. Unit Heaters
 - h. Water Heaters

C. Definitions

1. Life Safety Systems:
 - a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
 - b. All systems involved with and / or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.
 - c. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
2. Positive Attachment:
 - a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to

structure. Single sided SCB type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic attachment points.

3. Transverse Bracing:
 - a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.
4. Longitudinal Bracing:
 - a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.02 SUBMITTAL DATA REQUIREMENTS:

- A. The manufacturer of vibration isolation and seismic 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 seismic 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 suspended equipment.
 - c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
 - d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

- e. Piping and duct restraint locations shall be field documented during construction. Shop drawings of floor plan layouts shall be prepared indicating actual field conditions and restraint locations shall be clearly identified. Calculations, by a registered professional engineer, and restraint details shall be submitted to the project engineer for approval.

3. Seismic Certification and Analysis:

- a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
- b. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45 to the weakest mode.
- c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.03 CODE AND STANDARDS REQUIREMENTS:

A. Typical Applicable Codes and Standards:

- 1. The Arkansas Fire Prevention Code 2012, based on the International Building Code 2012.
- 2. Sheet Metal and Air Conditioning Contractors National Association's "Seismic Restraint Manual Guidelines for Mechanical Systems – Second Edition".
- 3. National Uniform Seismic Installation Guidelines.

4. NFPA 5000 – The Building Construction and Safety Code.

1.04 MANUFACTURER'S RESPONSIBILITY:

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
1. Determine vibration isolation and seismic restraint sizes and locations.
 2. Provide vibration isolation and seismic restraints as scheduled or specified.
 3. Provide calculations and materials if required for restraint of unisolated equipment.
 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.05 RELATED WORK:

- A. Housekeeping Pads:
1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
 2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
- B. Supplementary Support Steel:
1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof-mounted equipment, as required or specified.
- C. Attachments:
1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.06 SEISMIC FORCE LEVELS:

- A. The following are used to determine the “G” force levels used on this project based on the codes listed in Section 1.03.
1. Component amplification factor (a_p) for each type of component are as follows:
 - a. High Deformability Pipe = 1.0
 - b. Rigidly Mounted Equipment and Limited Deformability Pipe = 1.0
 - c. Vibration Isolated Equipment and Pipe, Pressure Vessels = 2.5
 - d. Low Deformability Pipe = 1.0
 2. Component Response Modification Factor (R_p) for each component are as follows:
 - a. High Deformability Pipe = 3.5
 - b. Rigidly Mounted Equipment and Limited Deformability Pipe = 2.5
 - c. Vibration Isolated Equipment and Pipe, Pressure Vessels = 2.5
 - d. Low Deformability Pipe = 1.25
- B. The following “G” force levels will be used on this project based on the codes listed in Section 1.03.
1. Spectral Response Acceleration at Short Periods (S_s) less than 0.15 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels

- a. Horizontal = 0.10
- b. Vertical = 0.05
- 4. Low Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.15
 - b. Vertical = 0.05
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.12
 - b. Vertical = 0.05
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.08

- b. Vertical = 0.05
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.20
 - b. Vertical = 0.05
- 4. Low Deformability Pipe
 - a. Horizontal = 0.16
 - b. Vertical = 0.05
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.08
 - b. Vertical = 0.05
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.10
 - b. Vertical = 0.05
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.25
 - b. Vertical = 0.05
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.16
 - b. Vertical = 0.05
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.09
 - b. Vertical = 0.05

2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.12
 - b. Vertical = 0.05
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.30
 - b. Vertical = 0.05
 4. Low Deformability Pipe
 - a. Horizontal = 0.24
 - b. Vertical = 0.05
2. Spectral Response Acceleration at Short Periods (Ss) between 0.15 and 0.25 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
- a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.17
 - b. Vertical = 0.08
 4. Low Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08

- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.25
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.08
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.34
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe

- a. Horizontal = 0.27
- b. Vertical = 0.08
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.13
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.42
 - b. Vertical = 0.08
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.34
 - b. Vertical = 0.08
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.14
 - b. Vertical = 0.08
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.08
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.50

- b. Vertical = 0.08
- 4. Low Deformability Pipe
 - a. Horizontal = 0.40
 - b. Vertical = 0.08
- 3. Spectral Response Acceleration at Short Periods (Ss) between 0.26 and 0.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.23
 - b. Vertical = 0.11
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.18
 - b. Vertical = 0.11
 - b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe

- a. Horizontal = 0.17
- b. Vertical = 0.11
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.34
 - b. Vertical = 0.11
- 4. Low Deformability Pipe
 - a. Horizontal = 0.27
 - b. Vertical = 0.11
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.18
 - b. Vertical = 0.11
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.46
 - b. Vertical = 0.11
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.36
 - b. Vertical = 0.11
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.17
 - b. Vertical = 0.11

2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.11
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.57
 - b. Vertical = 0.11
 4. Low Deformability Pipe
 - a. Horizontal = 0.46
 - b. Vertical = 0.11
- e. Above 3/4 of the Building Height up to the Roof
1. High Deformability Pipe
 - a. Horizontal = 0.20
 - b. Vertical = 0.11
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.27
 - b. Vertical = 0.11
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.68
 - b. Vertical = 0.11
 4. Low Deformability Pipe
 - a. Horizontal = 0.54
 - b. Vertical = 0.11
4. Spectral Response Acceleration at Short Periods (Ss) between 0.51 and 1.00 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.

- a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.29
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.15
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.44
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe

- a. Horizontal = 0.35
- b. Vertical = 0.15
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.23
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.58
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.47
 - b. Vertical = 0.15
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.22
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.29
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.73

- b. Vertical = 0.15
- 4. Low Deformability Pipe
 - a. Horizontal = 0.58
 - b. Vertical = 0.15
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 0.25
 - b. Vertical = 0.15
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.35
 - b. Vertical = 0.15
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.88
 - b. Vertical = 0.15
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.70
 - b. Vertical = 0.15
- 5. Spectral Response Acceleration at Short Periods (Ss) between 1.01 and 1.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe

- a. Horizontal = 0.30
- b. Vertical = 0.20
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.40
 - b. Vertical = 0.20
- 4. Low Deformability Pipe
 - a. Horizontal = 0.32
 - b. Vertical = 0.20
- b. Above Ground Level up to 1/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.60
 - b. Vertical = 0.20
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.48
 - b. Vertical = 0.20
- c. Above 1/4 up to 1/2 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30

- b. Vertical = 0.20
- 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.32
 - b. Vertical = 0.20
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.80
 - b. Vertical = 0.20
- 4. Low Deformability Pipe
 - a. Horizontal = 0.64
 - b. Vertical = 0.20
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.30
 - b. Vertical = 0.20
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.40
 - b. Vertical = 0.20
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.00
 - b. Vertical = 0.20
 - 4. Low Deformability Pipe
 - a. Horizontal = 0.80
 - b. Vertical = 0.20
- e. Above 3/4 of the Building Height up to the Roof

1. High Deformability Pipe
 - a. Horizontal = 0.34
 - b. Vertical = 0.20
2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.48
 - b. Vertical = 0.20
3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.20
 - b. Vertical = 0.20
4. Low Deformability Pipe
 - a. Horizontal = 0.96
 - b. Vertical = 0.20
6. Spectral Response Acceleration at Short Periods (S_s) greater than 1.50 based on a building Importance Factor = 1.0. For building Importance Factor = 1.5 multiply by 1.5.
 - a. Lower Levels and Ground Level
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 0.67
 - b. Vertical = 0.33

4. Low Deformability Pipe
 - a. Horizontal = 0.53
 - b. Vertical = 0.33
- b. Above Ground Level up to 1/4 of the Height of the Building
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.00
 - b. Vertical = 0.33
 4. Low Deformability Pipe
 - a. Horizontal = 0.80
 - b. Vertical = 0.33
- c. Above 1/4 up to 1/2 of the Height of the Building
 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.53
 - b. Vertical = 0.33
 3. Vibration Isolated Equipment and Pipe, Pressure Vessels

- a. Horizontal = 1.34
- b. Vertical = 0.33
- 4. Low Deformability Pipe
 - a. Horizontal = 1.07
 - b. Vertical = 0.33
- d. Above 1/2 up to 3/4 of the Height of the Building
 - 1. High Deformability Pipe
 - a. Horizontal = 0.50
 - b. Vertical = 0.33
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.67
 - b. Vertical = 0.33
 - 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 1.67
 - b. Vertical = 0.33
 - 4. Low Deformability Pipe
 - a. Horizontal = 1.34
 - b. Vertical = 0.33
- e. Above 3/4 of the Building Height up to the Roof
 - 1. High Deformability Pipe
 - a. Horizontal = 57
 - b. Vertical = 0.33
 - 2. Rigidly Mounted Equipment and Limited Deformability Pipe
 - a. Horizontal = 0.80

- b. Vertical = 0.33
- 3. Vibration Isolated Equipment and Pipe, Pressure Vessels
 - a. Horizontal = 2.00
 - b. Vertical = 0.33
- 4. Low Deformability Pipe
 - a. Horizontal = 1.60
 - b. Vertical = 0.33

1.07 QUALITY ASSURANCE:

- A. All vibration isolation and noise control devices shall be designed to meet the requirements of the latest edition of ASHRAE Handbooks.
- B. Noise Criteria:
 - 1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room.
 - 2. For equipment which has no sound power ratings scheduled on the plans, the Contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with the latest edition of ASHRAE Systems Handbook, Sound and Vibration Control chapter. An average value of 5 db shall be used as the room attenuating effect, i.e., the difference between sound power level emitted to room and sound pressure level in room.
 - 3. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
- C. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and / or horizontal permanent deformation greater than 1/4".

PART 2 - PRODUCTS

2.01 PRODUCT DESCRIPTIONS:

- A. Vibration Isolators and Seismic Restraints:
 - 1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load

distribution plates shall be used as required. Pads shall be type Super "W" as manufactured by Mason Industries, Inc.

2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type BR as manufactured by Mason Industries, Inc.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge-bearing quality. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.
4. A one piece molded bridge bearing neoprene washer / bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 % of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the

housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "R" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SLR or SLRS as manufactured by Mason Industries, Inc.

7. Spring mountings as in specification 5 built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SSLFH as manufactured by Mason Industries, Inc.
8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests. Air Springs shall be type MT and leveling valves type LV as manufactured by Mason Industries, Inc.
9. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be type SLR-MT as manufactured by Mason Industries, Inc.
10. Hangers shall consist of rigid steel frames containing minimum 1-1/4" thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis

hangers nor the neoprene element stacked on top of the spring. 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. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.

11. Hangers shall be as described in 10, but they shall be supplied with a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, and equipment. Rubber thickness shall be a minimum of 1/4". Submittals shall include a drawing of the hanger showing the installation of the rebound washer. Hangers shall be type RW30N as manufactured by Mason Industries, Inc.
12. Hangers shall be as described in 10, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
13. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be prestretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
14. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc.

a. Note: Specifications 12-14 apply to trapeze as well as clevis

hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

15. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
16. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
17. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" thick. Rated loadings 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. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be type Z-1225 as manufactured by Mason Industries, Inc.
18. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more than 1/4". Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be type Z-1011 as manufactured by Mason Industries, Inc.

19. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.
20. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.O. Evaluation Service, Inc. verifying to its allowable loads. Drill-in female wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.
21. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type WF as manufactured by Mason Industries, Inc.
22. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.
23. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal or structural steel sections containing adjustable and removable steel springs that support the upper floating section. The upper frame must

provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of 1/4" thick. Steel springs shall be laterally stable and rest on 1/4" thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous flexible flashing nailed over the lower curbs waterproofing. All spring locations shall have accessibility to adjust springs. Lower curbs shall have provision for 2" of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower section anchored to the roof structure. Curb shall have anchorage pre-approval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings. Curb shall be type SRSC or RMSS as manufactured by Mason Industries, Inc.

24. Curb mounted rooftop equipment shall be mounted on top of Rigid Seismic Roof curbs. Curb sections shall be designed by an engineer licensed in the state where the project is, and shall be either structural steel channels or 12-gauge sheet metal. Field assembled joints are to include a minimum of 2 rows of 3 bolts at each connection. Curb to have a factory installed wood nailer. The Rooftop unit must be fastened to the curb and the curb fastened to the structure to resist both seismic and wind forces. Submittal shall include calculations by a professional engineer licensed in the state, and the engineer shall have a minimum of 5 years experience in seismic applications. Curb details and unit connection to curb details shall be included. Curbs shall be type RRC as manufactured by Mason Industries, Inc. Curb shall match slope of the supporting structure.
25. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes 3/4" to 1-1/2" may have threaded two piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi up to 170° F with a uniform drop in allowable pressure to 215 psi at 250° F in sizes through 14". 16" through 24" single sphere minimum ratings are 180 psi at 170° F and 150 psi at 250° F. Higher rated connectors may be used to accommodate service conditions. All expansion joints must be factory tested to 150 % of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints. Expansion joints shall be installed in

pipng gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi maximum on the washer area. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be type SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

26. 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. Minimum lengths shall be as tabulated:

Flanged		
3" x 14"	6" x 20"	12" x 28"
4" x 15"	8" x 22"	14" x 30"
5" x 19"	10" x 26"	16" x 32"
Male Nipples		
1/2" x 9"	1-1/4" x 12"	2" x 14"
3/4" x 10"	1-1/2" x 13"	2-1/2" x 18"
1" x 11"		

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

27. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
28. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. 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 reinsertable to allow for selection of pipe movement. Guides shall be capable of +/- 5/8" motion, or to meet location requirements. Pipe guides shall be type VSG as

manufactured by Mason Industries, Inc.

29. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240° F, 10# density fiberglass may be used in lieu of the sponge. Seals shall be type SWS as manufactured by Mason Industries, Inc.
30. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI / WBD as manufactured by Mason Industries, Inc.
31. Housekeeping pad anchors shall consist of a ductile iron casting that is tapered and hexagonal, smaller at its base than at its top. The upper portion shall have holes for rebar to pass through. The anchor shall be continuously threaded from top to bottom for the attachment of soleplates. Housekeeping pad anchors shall be attached to the structural slab using a stud wedge anchor. Housekeeping pad anchors shall be type HPA and stud wedge anchor shall be type SAS both as manufactured by Mason Industries, Inc.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic 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 herein specified.

- D. The contractor shall not install any equipment, piping, duct or conduit, which 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. Any conflicts with other trades, which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions, should be brought to the architects / engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- G. Bring to the architects / engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- H. Correct, at no additional cost, all installations, which are deemed defective in workmanship and materials at the contractor's expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
 - 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Product specification 13 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Product specification 13 cable assemblies are installed taut on non-isolated systems. Product specification 14 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where product specification 13 or 14 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.
- M. At locations where product specification 13 cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be product specification type 11.
- N. At all locations where product specification 13 or 14 restraints are attached to pipe clevis, the clevis cross bolt must be reinforced with product specification type 16 braces.

- O. Drill-in concrete anchors for ceiling and wall installation shall be product specification type 19, and product specification type 20 female wedge type for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed product specification 25 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide product specification 29 wall seals.
- S. 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 restraint shall be product specification type 30.
- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. All fire protection piping shall be braced in accordance with NFPA 13 and 14.
- V. All mechanical equipment shall be vibration isolated and seismically restrained as per the schedules in part 4 of this specification.
- W. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment in table 1.06-1, if higher levels are shown.
- X. Contractor shall make provisions for attachments of seismic restraints with all required equipment.

3.02 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF PIPING:

- A. Horizontal pipe isolation: The first four pipe hangers in the main lines near the mechanical equipment shall be as described in product specification 12. Brace hanger rods with SRC clamps product specification 15. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in product specification 10 and 11. Floor supported piping shall rest on isolators as described in product specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have 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 three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1-

1/2" deflection for pipe sizes up to and including 6", and 2-1/2" deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Hanger locations that also have seismic restraints attached must have type RW Rebound Washers to limit uplift. Where piping connects to mechanical equipment install product specification 25 expansion joints or product specification 26 stainless hoses if 25 is not suitable for the service.

- B. Riser isolation: Risers shall be suspended from product specification 11 hangers or supported by product specification 5 mountings, anchored with product specification 27 anchors, and guided with product specification 28 sliding guides. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to +/- 25 % of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
- C. Seismic Restraint of Piping:
1. Seismically restrain all piping listed as a, b or c below. Use product specification 13 cables if isolated. Product specification 13 or 14 restraints may be used on unisolated piping.
 - a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1" I.D. or larger.
 - b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1-1/4" I.D. and larger.
 - c. All other piping 2-1/2" diameter and larger.
 2. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 3. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
 5. For fuel oil and all gas piping transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
 6. Transverse restraint for one pipe section may also act as a

longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.
9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly in areas with S_s of 0.35 or greater shall be braced as in sections 3.02.C.2 and 3. For areas with S_s less than 0.35, 2 band clamps may be used with a reduced spacing of 1/2 of those listed in sections 3.02.C.2 and 3.
10. Connection to the structure must be made with a non-friction connection (i.e. no "C" clamps).
11. Hanger locations that also have seismic restraints attached must have Product specification 11 type RW Rebound Washers.
12. Piping which crosses building expansion joints shall be anchored on each side of the expansion joint. Ball joints or braided hose assemblies shall be employed to allow the specified movement of the building without affecting the integrity of the piping system.

D. Pipe Exclusions:

1. Gas piping less than 1" inside diameter.
2. Piping in boiler and mechanical rooms less than 1-1/4" inside diameter.
3. All other piping less than 2-1/2" inside diameter.
4. All piping suspended by clevis hangers where the distance from the top of the pipe to the suspension point is 12" or less.
5. All trapezed piping where the distance from the suspension point to the trapeze member is 12" or less.
6. If any suspension location in the run exceeds the above, the entire run must be braced.

3.03 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF DUCTWORK:

A. Vibration isolation of ductwork:

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of product specification 10 hangers or product specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".
2. All duct runs having air velocity of 1000 fpm or more shall be isolated from the building structure by product specification 12 hangers or 5 floor supports. Spring deflection shall be a minimum of 0.75".

B. Seismic restraint of ductwork:

1. Seismically restrain all ductwork with product specification 13 or 14 restraints as listed below:
 - a. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
 - b. Restrain round ducts with diameters of 28" or larger.
 - c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
2. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
3. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
7. Connection to the structure must be made with a non-friction

connection (i.e. no "C" clamps).

8. Hanger locations that also have seismic restraints attached must have product specification 11 type RW Rebound Washers.

C. Ductwork Exclusions:

1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
2. Oval ducts that are less than 6 square feet in cross sectional area based on nominal size.
3. Round duct less than 28" in diameter.
4. All trapezed ductwork where the distance from the suspension point to the trapeze member is 12" or less.
5. Ductwork hung with straps where the top of the duct is 12" or less from the suspension point and the strap has 2 #10 sheet metal screws within 2" of the top of the duct.
6. If any suspension location in the run exceeds the above, the entire run must be braced.

PART 4 - SCHEDULES

4.01 EQUIPMENT ISOLATOR AND SEISMIC RESTRAINT SCHEDULE:

VIBRATION ISOLATION AND/OR SEISMIC RESTRIANT EQUIPMENT SCHEDULE

	Products	Static Deflection
AHU's/ERU's - Floor Mounted	4, 20	By Manufacturer
AHU's/ERU's - Suspended	11, 13, 15	By Manufacturer
Units Heaters - Suspended	11, 13, 15	None
Fans - Roof Curb Mounted	24	None
Fans - Suspended	11, 13, 15	1"
Ductwork	13, 15	None
Piping	13, 15, 16	None
Housekeeping Pads - All	31	None

Schedule Notes:

- A. Referenced products are list and described in part 2.02 of this specification section.
- B. If static deflection is not listed, then the product does not require resilient mounts, or spring hangers.
- C. Where no specification numbers are listed, the equipment identified still is required to be restrained. Mason Industries will provide engineering

calculations, and details. Mounting hardware will be provided by others.

END OF SECTION 15073

SECTION 15090 SUPPORTS ANCHORS AND SEALS

PART 1 – GENERAL

- 1.1 SCOPE: Provide adequate pipe, duct, and equipment foundation and suspension systems in accordance with recognized engineering practices, using where possible, standard, commercially accepted hangers and accessories.
- 1.2 QUALITY ASSURANCE:
- A. Equipment listed in this section shall be as specified or equal. Firms regularly engaged in manufacturer of supports, anchors, and seals of types and sizes required, whose products have been in satisfactory use in similar service will be considered for approval.
 - B. All pipe hangers and supports shall conform to the latest requirements of the ASA Code for Pressure Piping, B31.1 and Manufacturer's Standardization Society Documents MSS-SP-58 and MSS-SP-69, and ANSI code for pressure piping B31.1.0.
 - C. All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook.
- 1.3 DESIGN:
- A. The Contractor shall be responsible for the pipe and duct supporting systems.
 - B. Where thermal movement in the pipeline will occur, the pipe hanger assembly must be capable of supporting the line in all operating conditions. Accurate weight balance calculations shall be made to determine the supporting force at each hanger in order to prevent excessive stress in either pipe or connected equipment.
- 1.4 DELIVERY, STORAGE AND HANDLING: Deliver all supports, anchors and seals to the job site in original, new and unopened packages bearing manufactures name and label.

PART 2 – PRODUCTS

- 2.1 PIPE HANGERS AND SUPPORTS:
- A. Hanger rods shall be hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turnbuckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread carbon steel rods shall be acceptable.
 - B. Beam Clamps: Equal to Grinnell C-clamp, malleable iron Figure 86 with locknut or Figure 61.
 - C. Pipe Hangers: All hangers for piping shall be provided with means of vertical adjustment.
 - 1) On uninsulated steel pipe, hangers shall be carbon steel clevis type, equal to Grinnell Figures 65 or 260. On piping 2" and smaller, furnish carbon steel hangers with zinc finish equal to Grinnell Figures 69 or 70 swivel ring hangers.
 - 2) On uninsulated copper tubing, hangers shall be carbon steel with copper finish equal to Grinnell Figures CT-69, swivel ring hanger or CT-65 clevis hanger.
 - 3) On insulated piping, hangers shall be carbon steel clevis type equal to Grinnell Figures 65 or 260, and shall be placed on the outside of the insulation with an 18

gauge galvanized shield to distribute the hanger load over the insulation and to eliminate damage to the vapor barrier on the covering.

- 4) Hangers for cast iron soil pipe shall be carbon steel clevis type, equal to Grinnell Figure 590 and Figure 65.
- D. Brackets and Racks: Welded steel brackets shall be equal to Grinnell Figures 194, 195, 199, or as detailed on drawings. Multiple pipe racks or shall be fabricated from channel, angle iron, clamps and accessories, as detailed on drawings.
- E. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Trapeze hangers shall not be permitted for steam supply and return piping.
- 1) Allowable hanger load: Manufacturers rating less 200 pounds.
 - 2) Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, for insulated piping at each hanger.
 - 3) Steam piping will not be permitted on trapeze hangers.
- F. Riser Clamps: Riser clamps shall be carbon steel, equal to Grinnell Figure 261 or carbon steel copper coated CT121. Size riser clamps for actual pipe size in all cases.
- G. For Attachment to Concrete Construction:
- 1) Concrete insert shall comply with Type 18, MSS SP-58.
 - 2) Self-drilling expansion shields and machine bolt expansion anchors shall comply with Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-325.
 - 3) Power-driven fasteners shall be permitted in existing concrete or masonry not less than four inches thick when approved by the Structural Engineer for each job condition. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-325.
- 2.2 COPPER PIPING: Non insulated copper piping supported by a metal framing system, shall be secured to the metal framing by B-Line's B2000 series clamps with B1999 "Vibra Cushion" elastomeric isolator or approved equal. The elastomer shall be rated for -75 degrees F to +375 degrees F operation. Clamp and elastomer shall accommodate pipe and tubing sizes from 1/4" to 8".
- 2.3 METAL FRAMING SYSTEMS:
- A. Provide all metal framing, fittings, and related accessories and labor as indicated to support HVAC equipment, ductwork, piping, controls, etc equal to Unistrut or B-Line.
 - B. All channel members shall be fabricated from structural grade steel conforming ASTM A 570 GR 33 or ASTM A 446 GR A.
 - C. All fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A 575, A 576, A 36 or A 635.

- D. Components shall be finished with rust inhibiting acrylic enamel paint applied by electro-deposition, after cleaning and phosphating, and thoroughly baked.
- 2.4 DUCT HANGERS AND SUPPORTS: Refer to Section 15800.
- 2.5 SLEEVES:
- A. Sleeves in concrete or masonry construction, and where collapse is possible, shall be Schedule 40 pipe, or Type K copper. Other sleeves shall be minimum 22-gauge sheet metal.
- B. Sleeves accommodating insulated pipe shall be sufficient diameter to pass piping and full size of insulation. Otherwise sleeves shall be two (2) pipe sizes larger than the pipe served.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
- 1) For sleeves: Extend sleeve one inch above finished floor and furnish and install sealant for watertight joint.
 - 2) For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 - 3) For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- D. Furnish and install cast iron pipe sleeves for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- E. All sleeves for piping through exterior wall and mechanical rooms shall be sealed.
- F. Spring clamp plates or set screw escutcheons shall be provided where pipes are exposed in occupied rooms and where walls, floors or ceilings are finished. Plates on extended sleeves shall have chrome-plated skirts.
- 2.6 ESCUTCHEONS: Furnish and install manufactured wall, ceiling, and floor plates to conceal protruding fittings and sleeves. The inside diameter shall closely fit around pipe, tube, and insulation of insulated piping. The outside diameter shall completely cover opening. Escutcheons in concealed spaces shall have a rough brass finish. Escutcheons in exposed spaces shall have a polished chrome plate finish. Escutcheons shall be either one piece or split casing with concealed hinge and set screw.
- 2.7 PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
- 2.8 FLASHING: Piping and ductwork passing through the roof shall be flashed with a galvanized flashing collar and storm collar in accordance with the architectural details.
- 2.9 FIRE-STOPPING:
- A. Fire-stopping materials shall consist of commercially manufactured products complying with the following minimum requirements:
- 1) Flame Spread Index: Twenty-five or less when tested in accordance with ASTM E84.

- 2) Smoke Density Index: Fifty or less when tested in accordance with ASTM E84.
 - 3) Toxicity: Nontoxic to human beings at all stages of application and during fire conditions.
 - B. Fire-stopping materials used to seal penetrations in time-rated assemblies shall be capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 time-temperature fire conditions for either 1 or 2 hours as required.
 - C. Fire-stopping materials shall not require a rise in temperature to install or seal.
- 2.10 ROOF CURBS:
- A. Furnish and install pre-fabricated roof curbs where required for roof openings. Prefabricated roof curbs shall have a box section constructed of 18 gauge galvanized steel with continuous welded seams. Curb shall have fully mitered and welded corners, integral water deflecting cricket and shall be insulated with 1-1/2", 3 pcf rigid fiberglass board. Roof curbs shall be internally reinforced on any side longer than 3'-0" and shall have factory installed integral base plate. Height shall be 8" above roof finish rain shed level.
 - B. Contractor field fabricated roof curbs shall not be acceptable.
 - C. Roof curbs for fans and ventilators shall be furnished with equipment.
- 2.11 PIPE FLASHING:
- A. Furnish and install the Deck-Mate, or approved equal, as manufactured by Roof Products and Systems Corporation, at all points where continuous pipes penetrate the roof.
 - B. The pipe flashing shall be constructed of EPDM (Ethylene Propylene Diene Monomer, or Neoprene compression molded rubber material. Material shall have a serviceable temperature range of -60o F to 270o F and be resistant to ozone and ultraviolet rays.
 - C. Unit shall have 1" wide corrosion resistant flexible aluminum base. The base flange shall be incorporated to a pleated expansion joint. Pipe flashing shall accommodate pipes up to 18" in diameter.
- 2.12 EQUIPMENT RAILS: Furnish and install equipment rails equal to Roof Products and Systems Model ER where indicated on the Plans. Prefabricated equipment rails shall be manufactured from 14 gauge galvanized steel. Equipment rails shall have internal reinforcement with an integral base plate, fully mitered and welded corners, a 3" cant, and a factory installed 2 x 4 wood nailer. Height to be 8" above finished roof. Equipment rails shall span a minimum of two joists and not cantilever more than 6". Equipment rails shall be level at the top with pitch built-in when deck slopes 1/4" per foot or greater. Contractor fabricated equipment rails will not be accepted.

PART 3 – EXECUTION

- 3.1 ATTACHING TO STRUCTURE: Where equipment or piping is supported from building steel beams, clamps or welded beam attachments shall be used. Holes drilled in building steel for hanger support rods will NOT be permitted.
- 3.2 HANGER RODS AND SPACING:

- A. Where hanger rod sizes are catalog-listed for a specified hanger, this size shall govern. Where hanger rod sizes are not catalog-listed, the load on the hanger shall be the determining factor and the maximum recommended hanger rod load as catalog-listed, shall govern.
- B. Hangers shall be placed at every change in direction. Pipe hanger spacing shall not exceed:

STEEL PIPING			COPPER PIPING		
PIPE SIZE	SPACING	ROD SIZE	PIPE SIZE	SPACING	ROD SIZE
1/2" to 3/4"	5'	3/8"	1/2" to 1"	6'	3/8"
1" to 2"	7'	3/8"	1-1/4" to 2"	10'	3/8"
2-1/2" to 3"	11'	1/2"	2-1/2" to 3"	12'	1/2"
4" to 5"	14'	5/8"			

3.3 AUXILIARY STEEL:

- A. Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment. Material members shall be consistent with that of the main structural system.
- B. Torch cut ends of auxiliary steel shall be ground to a smooth surface finish. Welding shall comply with AWS D.1.1 "Structural Welding Code – Steel".
- C. Arrange for any adjustment necessary in main structural system for proper support of major equipment.
- D. All auxiliary steel shall be finished with one shop coat of primer paint. After fabrication and erection, welds shall be painted with an additional primer coat.

3.4 METAL FRAMING INSTALLATION:

- A. Installation shall be accomplished by a fully trained manufacturer authorized installer.
- B. Set framing components into final position true to line, level and plumb, in accordance with approved shop drawings.
- C. Anchor materials firmly in place. Tighten all connections to their recommended torques.

3.5 CONCRETE PADS:

- A. Provide concrete pads under all floor-mounted equipment and apparatus as described on drawings. Construct concrete bases of dimensions indicated, but not less than six inches larger in both directions than supported unit.

- B. All pads for pumps shall be a nominal 8" thick unless otherwise noted on the drawings. All pads for air handlers with base rails shall be a nominal 8" thick unless otherwise noted on the drawings. All pads for air handlers without base rails shall be a nominal 12" thick unless otherwise noted on the drawings. All remaining equipment shall set on 4" thick concrete pads.
- C. Concrete pads for reciprocating action equipment shall be pin anchored to concrete slab.
- D. The Contractor shall provide all necessary anchor bolts, together with templates for holding bolts in position.

3.6 SLEEVES AND PLATES:

- A. Sleeves shall be used where piping passes through exterior walls, floor or roofs; where required for sealing to meet any sanitation codes, ordinances or laws; and areas where water may accumulate.
- B. In toilets, equipment rooms and other areas where water may accumulate on the floor, sleeves shall extend 1" above the finished floor. Other sleeves shall be flush with finished floor.
- C. After all piping has been inserted in sleeves, voids between pipe or insulation and sleeve shall be filled with a suitable non-run, non-stain elastomeric mastic.
- D. Riser clamps on chilled water piping shall be raised above the floor level a minimum of 2" with auxiliary steel attached to riser clamp to allow insulation of riser clamp.
- E. Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1) Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2) Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3) Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

3.7 ESCUTCHEONS: Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

- A. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
- B. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
- C. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
- D. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
- E. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

3.8 PAINTING AND PRIMING: Paint all piping and hangers exposed in finished areas or outside as directed in Section 09900.

3.9 FIRE-STOPPING:

- A. Install a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and to maintain the integrity of the time rated construction. Fire-stopping shall be provided in, but not limited to, the following locations:
 - 1) Duct and pipe penetrations through above grade floor slabs and through time-rated partitions and fire walls.
 - 2) Penetrations of vertical shafts such as pipe chases.
 - 3) Other locations where indicated by drawings or required by code.
- 3.10 ROOF CURBS: Install pre-manufactured roof curbs in accordance with manufacturer's instructions.
- 3.11 PIPE MOUNTING PEDESTALS: Install pre-manufactured pipe mounting pedestals in accordance with manufacturer's instructions.
- 3.12 ROOF MOUNTED PIPE SUPPORT SYSTEM:
 - A. Verify that roofing system is complete, and that roof surfaces are smooth and flat and are ready to receive work.
 - B. Verify that roof temperature is a minimum of 60 degrees F for proper adhesive performance.
 - C. Use care in installation of pipe support systems not to damage roofing, flashing, equipment or related materials.
 - D. Clean surfaces of roof to receive pipe support bases. Remove gravel from gravel surfaced roofs, remove dirt, dust, oils, and other foreign materials from all roofs. Prime existing membrane with a primer that is compatible with existing components in the roofing system.
 - E. Bases and support framing shall be located as indicated on drawings and as specified herein. The support of all piping shall be complete and adequate, whether or not all required devices are shown.
 - F. Set bases with adhesive in accordance with manufacturer's installation instructions. Accurately locate and align bases. Where applicable, replace gravel around bases. Install strut framing as indicated by pipe system manufacturer's instructions.
- 3.13 DUCT MOUNTING PEDESTALS: Install pre-manufactured duct mounting pedestals in accordance with manufacturer's instructions.

END OF SECTION 15090

SECTION 15200 NOISE VIBRATION AND EXPANSION

PART 1 – GENERAL

- 1.1 SCOPE: It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration and noise to the building structure. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements of the specifications.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15060 - PIPE AND PIPE FITTINGS; 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; 15600 - HVAC EQUIPMENT; and 15800 - AIR DISTRIBUTION.
- 1.3 QUALITY ASSURANCE:
- A. All vibration isolation devices shall be designed and furnished by a single manufacturer or supplier. All vibration isolation and noise control devices shall be designed to meet the requirements of latest edition of ASHRAE Systems Handbook. Equipment shall be of the type specified herein or appeared equal.
- B. Noise Criteria:
- 1) Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room.
 - 2) For equipment which has no sound power ratings scheduled on the plans, the Contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with the latest edition of ASHRAE Systems Handbook, SOUND AND VIBRATION CONTROL chapter. An average value of 5 db shall be used as the room attenuating effect, i.e., the difference between sound power level emitted to room and sound pressure level in room.
 - 3) In absence of specified measurement requirements, measure equipment noise levels three (3) feet from equipment and at an elevation of maximum noise generation.
- C. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20-inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.
- 1.4 SUBMITTALS: Submit for approval all isolation and expansion specialties under this section of the specifications. Submittal data shall indicate type, size and deflection of each isolator.
- 1.5 DELIVERY, STORAGE AND HANDLING: Deliver all equipment to the job site in original, new and unopened packages bearing manufactures name and label.

PART 2 – PRODUCTS

- 2.1 ELASTOMERIC ISOLATOR: Furnish and install in sufficient quantities, where indicated on the drawings or required to reduce vibration and noise, elastomeric isolators equal to Amber-Booth NR series 3/8" thickness, ribbed neoprene pads. Elastomeric isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness

- of 60 durometer and have a straight-line deflection curve. Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed. Color code isolator by type and size for identification of capacity.
- 2.2 RUBBER-IN-SHEAR ISOLATOR: Furnish and install in sufficient quantities, where indicated on the drawings or required to reduce vibration and noise, isolators equal to Amber-Booth RV series rubber-in-shear vibration isolators with nominal 1/4" deflection.
- 2.3 RUBBER-IN-SHEAR EQUIPMENT HANGERS: Furnish and install where indicated on the drawings or required to reduce vibration and noise, equipment hangers equal to Amber-Booth HRD series, steel hanger with double deflection type neoprene grommet mount having a nominal 1/4" deflection.
- 2.4 SPRING EQUIPMENT HANGERS: Furnish and install where indicated on the drawings or required to reduce vibration and noise, equipment hangers equal to Amber-Booth BSR series having a nominal 1" deflection. Spring shall be 2" O.D., mounted in a rectangular steel box capable of 200 % minimum overload, with spring retainers, neoprene impregnated fabric washer and steel washer. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 30 degree angular misalignment without rubbing on hanger box.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Provide structural and other equipment required to control expansion and contraction of piping, loops and offsets. Rigidly anchor pipe to building structure. Where necessary provide pipe guides so that movement takes place along axis of pipe only.
- B. Provide all necessary auxiliary steel for proper operation and installation of isolation equipment.
- C. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise.
- D. Vibration Isolation:
- 1) No metal-to-metal contact will be permitted between fixed and floating parts.
 - 2) Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports.
 - 3) Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
 - 4) Provide heat shields where elastomers are subject to temperatures over 100° F.
 - 5) Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.

- E. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.
- F. Where excessive noise is generated in a piping system, due to arrangement or velocity of the fluid within the pipe, the Contractor shall, at his expense, make modifications as required or as directed by the Engineer to reduce noise to an acceptable level.

END OF SECTION 15200

SECTION 15250 MECHANICAL SYSTEMS INSULATION

PART 1 – GENERAL

- 1.1 SCOPE: Furnish and install insulation, coverings and sealants for equipment, piping and ductwork as specified and shown on the drawings.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; 15600 - HVAC EQUIPMENT; and 15800 - AIR DISTRIBUTION.
- 1.3 QUALITY ASSURANCE:
 - A. Insulation shall be manufactured in accordance with ASTM, UL and NFPA standards and meet the requirements of a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Insulation shall be of the type specified herein or approved equal.
 - B. Installer: A firm with at least five (5) years of successful installation experience on projects with work similar to this project.
- 1.4 SUBMITTALS: Submit for approval product data sheets on all insulation, material safety data sheets, and a written description of methods and thickness intended for insulating all piping services and ductwork, including but not limited to insulation types and thickness for each service and associated materials including but not limited to; vapor retarders, mastics, jackets and covers and sealing tape.
- 1.5 DELIVERY, STORAGE & HANDLING: Deliver all materials to the job site in original, new and unopened packages bearing manufacturers name and label. Store insulation and accessories inside building in a designated area clean from other trades. Protect insulation against dirt, water and damage. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 – PRODUCTS

- 2.1 MATERIALS:
 - A. Fiberglass (Mineral Fiber) Pipe Insulation: Thermal conductivity shall be no greater than 0.23 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C547 and rated for 0o to 850o F. Pipe insulation shall be furnished with factory applied white all service (ASJ) vapor barrier jacket with self-sealing lap (ASJ-SSL). Fittings shall be pre-molded from same material. Fiberglass pipe insulation shall be equal to Owens - Corning "Fiberglas SSL II".
 - B. Flexible Elastomeric Cellular Insulation: Thermal conductivity shall be no greater than 0.27 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C534, and rated for a maximum service temperature of 200o F. The flame spread rating shall be less than 25, and smoke developed rating shall be less than 50, equal to Armstrong AP Armaflex.
 - C. Fiberglass (Mineral Fiber) Duct Insulation Board: Thermal conductivity shall be no greater than 0.23 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C177 and rated for -20o to 450o F. Duct insulation shall be furnished with a two (2) mil foil scrim kraft vapor barrier (FSK) and have a density of three (3) pcf. Insulation board shall be equal to Knauf.

- D. Fiberglass (Mineral Fiber) Duct Insulation Wrap: Thermal conductivity shall be no greater than 0.36 btu in / hr sq. ft o F at 75o F mean temperature per ASTM C177 at twenty-five (25) percent compression. Insulation shall be rated for -20o to 450o F. Duct insulation shall be furnished with a two (2) mil foil scrim kraft vapor barrier (FSK) and have a density of 0.75 pcf. Insulation wrap shall be equal to Knauf.

2.2 PLUMBING:

- A. Evaporator (Cooling Coil) Condensate Drain Line: Insulate pipe including P-trap and trap arm with 1" inch thickness fiberglass insulation.

2.3 HVAC:

A. Above Grade Pipe Insulation (Flexible Elastomeric Cellular):

- 1) Insulate refrigerant suction piping (indoors) and humidity condensate drains with 1" thickness elastomeric insulation.
- 2) Insulate refrigerant suction piping outdoors with 1" inch thickness elastomeric insulation.

B. Ductwork:

- 1) The following square and rectangular ductwork within mechanical rooms shall be externally insulated with 1" inch thick rigid fiberglass board or semi rigid tank wrap.
 - a) Supply Air Ductwork
 - b) Return Air Ductwork
 - c) Outside Air Ductwork
- 2) All supply, return and outside air ductwork above ceilings shall be insulated with 2" inch thickness fiberglass duct wrap.
- 3) The top of all supply grilles shall be insulated with 2" inch thickness fiberglass duct wrap.
- 4) Supply air ductwork on the roof shall be insulated with 2" inch thickness rigid fiberglass board or semi rigid tank wrap.
- 5) External ductwork insulation shall be factory labeled at intervals not greater than 36" inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

2.4 MISCELLANEOUS MATERIALS:

A. Jacketing:

- 1) Exterior Piping: Aluminum jacketing shall be constructed of smooth 0.016 inch thickness ASTM B 209, Alloy 3003, H14 temper aluminum. All ell covers shall be two (2) piece, factory fabricated type, made of 0.020 inch thick 3003 sheet aluminum. Bands shall be 3/8" wide, 0.015" inch thickness aluminum up to 8" inch diameter pipe and 3/4" wide, 0.015" inch thickness aluminum on pipes sizes larger than 8" inch diameter.

B. Mechanical Fasteners:

- 1) Weld-Attached Anchor Pins and Washers: Copper coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated. Welded pin holding capacity shall be a minimum 100 lb for direct pull perpendicular to the attached surface.
 - 2) Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 3) Staples: Outward clinching monel or stainless steel.
 - 4) Wire: 18 gage soft annealed galvanized, or 14 gage copper clad steel or nickel copper alloy.
 - 5) Bands: 3/4" inch nominal width, brass, galvanized steel, aluminum or stainless steel.
- C. Reinforcement and Finishes:
- 1) Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
 - 2) Hexagonal wire netting: 1" inch mesh, 22 gage galvanized steel.
 - 3) Corner beads: 2" inch by 2" inch 26 gage galvanized steel; or 1" inch by 1" inch 28 gage aluminum angle adhered to 2" inch by 2" inch Kraft paper.
- D. Tapes:
- 1) Metallic Sealing Tape: Aluminum tape shall be 3" inch width (minimum) with 15 mils of elastomeric modified butyl adhesive on two (2) mil foil backing. Tape shall comply with UL 181B-FX and shall be equal to Hardcast "Foil Grip".
 - 2) Tape for Flexible Unicellular Insulation: Scotch No. 472, Nashua PE 12, or approved equal recommended by the insulation manufacturer.
 - 3) Glass Fiber Fitting Tape: Mil. Spec. MIL C 20079, Type II, Class 1.

PART 3 – EXECUTION

3.1 GENERAL:

- A. The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner, with jackets and facings drawn tight and smoothly cemented at all laps. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes and industry standards.
- B. On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Provide semi-circular protection saddles of #18-gauge galvanized steel, 12" long, for insulated piping where hangers occur. On pipe sizes 3" and over, provide pressure treated wood blocking matching insulation thickness, at hangers. Steel protection saddles shall be used at steam piping. Space between pipe and roller hanger inside saddle shall be insulated.

- D. Insulation shall be continuous through walls, ceiling or floor opening, or sleeves; except where firestop or fire saving materials are required.
- E. All exposed ends of pipe insulation shall be pointed up neatly with appropriate insulating cement.
- F. Piping and ductwork systems shall be tested and cleaned before insulation is applied.
- G. All insulated piping exposed to weather, shall be protected by an aluminum jacket. Jacket shall overlap not less than 2" inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12" inch centers. Longitudinal joints shall be overlapped down to shed water. Circumferential joints shall be sealed with a coating recommended by the insulation manufacturer for weatherproofing seams and joints in aluminum jackets. All ell covers shall be secured with adjustable metal bands on 18" inch centers. All screws used on aluminum jackets and fittings shall be stainless steel with neoprene gaskets. The heads of screws shall be covered with GE RTV silicone. Install aluminum angle ring escutcheons at wall penetrations.

3.2 INSTALLATION:

- A. Pipe and Fittings with Fiberglass Insulation:
 - 1) Locate all seams in the least visible location for exposed pipe. All piping below ambient temperatures shall be installed with a continuous vapor barrier. All joints, seams and fittings shall be sealed. All ends must be firmly butted and secured with appropriate butt strip material. All ends cut for termination of insulation shall be completely sealed. On high temperature piping (200o F and higher) apply double layer with staggered joints of strip material. Elbow fittings shall consist of heavy-density molded factory fitting insulation or mitered fitting insulation, covered with a vapor seal of glassfab and mastic or PVC cover. Diaper type low density insulation will not be acceptable.
 - 2) Linear voids of flexible pipe connectors shall be built up to a smooth contour to the limits of the high point of the adjoining flange or union fitting with continuous wrappings of insulation material secured in place by copper wire ties. Complete assembly shall then be covered by a continuous wrap vapor barrier material. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2" overlap to tape or mastic.
 - 3) Valves and fittings on all piping shall be completely insulated with fiberglass block insulation. Vapor retarders shall overlap a minimum of 2" at all seams and be sealed with appropriate pressure sensitive tape or mastic. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2" overlap to tape or mastic.
 - 4) All cut openings or other penetrations on insulated pipes for pressure gauges, thermometers, pressure and temperature plugs, flow switches, pressure sensors, temperature sensors, etc. shall be sealed vapor tight. Sufficient layers of waterproof mastic shall be applied to avoid water ponding and damage to insulation.
 - 5) Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 3/4" inch

and smaller shall not be insulated. Insulate piping to within 3" inches of un-insulated devices.

- 6) For flanges on piping conveying fluids 60o F or below:
 - a) Apply pipe insulation to outer diameter of pipe flange.
 - b) Width of insulation segment shall be the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - c) Voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments shall be filled with cut sections of sheet insulation of the same thickness as pipe insulation.
 - d) Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage to air to the pipe surface.
 - 7) Direct expansion piping shall be vapor sealed and completely insulated to the coil connection.
 - 8) Self-sealing laps may be used provided the lap seal is additionally sealed with a vapor barrier mastic.
- B. Pipe and Fittings with Elastomeric Insulation:
- 1) Install the proper size insulation, do not stretch or strain insulation. Where possible, slip insulation over the pipe or tubing prior to connection, and brush a light coat of manufacturer's recommended adhesive (equal to Armstrong 520) to all seams and butt joints. Insure all seams are fully covered with adhesive and the surface nearest the pipe pressed together first and evenly before joining the entire surface.
 - 2) For all exterior piping, apply manufacturer's recommended adhesive, equal to Armstrong 520, one (1) layer of fiberglass fabric and two (2) coats of white pigmented acrylic latex, equal to Armaflex WB finish. Allow bonded glass mesh to dry one (1) hour before application of weatherproof finish.
 - 3) On all runouts with elastomeric pipe insulation, brush a light coat of manufacturer's recommended adhesive to both surfaces and allow the adhesive to set until dry to the touch. All seams and butt joints must be fully covered with adhesive and the surface nearest the pipe should be pressed together first and evenly before joining the entire surface.
- C. Ductwork:
- 1) External Board Insulation: Secure board insulation with adhesive and anchor pins and speed washers.
 - a) External board insulation on square and rectangular ducts shall be attached with welded pins conforming to SMACNA MF-1-1971 secured by adhesive conforming to ASC-A-2001A-1971.
 - b) Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 - c) Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

- d) Space anchor pins as follows:
 - i. On duct sides with dimensions 18" inches and smaller, along longitudinal centerline of duct. Space 3" inches maximum from insulation end joints, and 16" inches o.c.
 - ii. On duct sides with dimensions larger than 18" inches: Space 16" inches o.c. each way, and 3" inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - iii. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - iv. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces.
 - 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.
 - f) All joints and breaks in facing shall be sealed with 3" wide, 0.002 aluminum foil scrim facing pressure sensitive tape.
 - g) Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - h) Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6" inches o.c.
 - i) Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- 2) Duct Wrap: Secure blanket insulation with adhesive and anchor pins and speed washers.
- a) Install duct wrap to obtain specified R-value using maximum compression of 25 %. Pull jacket tight and smooth. Install thickness in accordance with the specifications.
 - b) Impale insulation over anchors and attach speed washers. 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.
 - c) Create a facing lap for longitudinal seams and end joints with insulation by removing 2" inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2" inch staples, 1" inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 - d) Overlap unfaced blankets a minimum of 2" inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18" inches o.c.

- e) Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - f) Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6" inches o.c.
 - g) All seams shall be sealed with pressure-sensitive tape matching the insulation facing. Seal all tears, punctures, and other penetrations of the duct wrap facing with tape or mastic to provide a vapor-tight system.
 - h) Pressure sensitive tapes shall be a minimum 3" inches wide and applied with a moving pressure using an appropriate tool as recommended by the manufacture.
 - i) On flat surfaces over 18" inches wide, duct wrap shall be additional secured to the bottom of the ductwork using mechanical fasteners on 18" inch centers, without over compression of the insulation.
- 3) Ductwork in mechanical rooms and exposed duct shall be covered with an eight (8) ounce canvas material sized with a lagging adhesive meeting NFPA 90A flame and smoke requirements.
- D. Duct liner shall be adhered to the sheet metal plenum with 100 % coverage of adhesive conforming to ASC-A-7001A-1971. All exposed leading edges and transverse joints shall also be coated with adhesive. Mechanical fasteners conforming to SMACNA MF-1-1971 shall be used to additionally secure the duct liner. Fasteners shall be installed within 3" of edges and maximum 12" on centers.
- E. Protect outdoor duct insulation from weather by installing a weather-barrier mastic protective finish. Insulation shall be applied with an adhesive recommended by the insulation manufacturer, at a rate of one (1) per two (2) square feet of surface area on ductwork, transitions, silencers etc. After adhesive has dried, insulation board shall be impaled onto hangers and secured by speed clips. A weatherproof mastic equal to Lion Oil Company's "Seal Kote", 1/16" minimum thickness, shall be applied to the surface of the ductwork. A layer of glass fiber reinforcement shall then be applied. A final trowel grade of mastic, 1/16" minimum thickness, shall be then be applied. Protect mastic coating by installing an aluminum jacket.

END OF SECTION 15250

SECTION 15400 - PLUMBING EQUIPMENT

PART 1 - GENERAL

- 1.1 SCOPE: Furnish and install all fixtures, equipment and specialties shown on the plans or specifications. Provide all necessary supports, trim and accessories required.
- 1.2 RELATED WORK: Refer to the following sections of these specifications: 15060 - PIPE AND PIPE FITTINGS; 15090 - SUPPORTS, ANCHORS AND SEALS; 15100 - VALVES AND SPECIALTIES; and 15250 - MECHANICAL SYSTEMS INSULATION.
- 1.3 QUALITY ASSURANCE: All equipment, fixtures and trim shall be manufactured to meet all applicable ANSI, Federal Specifications, and UL requirements. Equipment and fixtures shall be as specified herein or equal.
- 1.4 SUBMITTALS: Submit for approval product data sheets on all equipment, fixtures and trim specified in this section of the specifications.
- 1.5 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver plumbing equipment and fixtures individually wrapped in factory fabricated containers.
 - B. Handle plumbing equipment and fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing equipment or fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

- 2.1 FIXTURES:
 - A. Fixtures shall be non-absorbent throughout and free from waves, film marks or discoloration. All surfaces coming in contact with walls, floors or other flat surfaces shall be flat.
 - B. All enameled ironware shall be acid resisting. All exposed finished metal parts shall be chromium plated; except, rough-bodied parts shall be nickel-plated.
 - C. All supplies shall be I.P.S. brass; except, where otherwise specified. All fixtures shall be provided with some form of supply stop. Traps for lavatories and sinks shall be chrome-plated cast brass P-traps with cleanout.
- 2.2 DOMESTIC WATER HEATERS:
 - A. DOMESTIC WATER HEATERS (WH-1):

- 1) Domestic water heaters shall be of the vertical, cross-flow, 2-pass, semi-instantaneous type, having service water in the shell and steam in the coils.
- 2) The heat exchanger shall be configured for condensate subcooling such that no condensate leaves the unit at a temperature in excess of 160 deg. F regardless of inlet steam pressure when the temperature of the incoming cold water is 110° F or less.
- 3) Domestic water heaters shall be furnished with 1-1/2" insulation, bronze T & P relief valve, shell drain valve, condensate outlet union orifice, condensate swing check valve, pneumatic control valve, and self-contained temperature control system.
- 4) Control system shall consist of a integral demand anticipator, dual solenoid valve, dynamically balanced pneumatic temperature controller with Class VI ANSI standard seating, over-temperature limit system, power on and tripped status lights, remote capillary thermometer, and compound steam gauge. Control system shall regulate the final temperature within +/- 4 deg. F of the desired temperature at all domestic load conditions.
- 5) Heat exchanger shall be constructed of multiple, individually replaceable, helically wound coils. Coils shall be capable of withstanding up to 30" w.c. internal vacuum. Each coil shall automatically and independently self-descale. Heat exchanger design shall be suitable for cleaning by method of thermal shock.
- 6) Water vessel shall be designed to allow no greater than one (1) FPS average velocity through the shell at design flow conditions to ensure no heat exchanger erosion. Total domestic water pressure drop through the heat exchanger shall no exceed one (1) psi at design flow. Water vessel shall be designed and manufactured in accordance with ASME Section VIII, Div 1 for no less than 235 psig at 400 deg. F working pressure and temperature.
- 7) Pressure vessel and heat exchanger surfaces in contact with the domestic water shall be copper or copper alloy. Materials of construction shall be 3/16" carbon steel shell with solid sheet copper liner, 0.065" wall copper coils, Schedule 80 red brass steam and condensate risers, and bronze top and bottom heads.
- 8) Domestic water heaters shall be rated for the water flows, temperature rise, steam flow, and steam pressure indicated on the Drawings.

2.3 HOSE BIBBS:

- A. Freeze Proof Hose Bibbs (HB-1) shall be equal to Woodford Model 65, 3/4" size, with chrome finish brass casting face, backflow preventer, union elbow inlet, wall clamp and key handle.

2.4 TRAPS AND DRAINS:

- A. General: Deep seal P-traps shall be placed under all floor drains and where indicated in wastes and at other points indicated on plans. P-traps shall be heavy cast iron bell and spigot pattern.

2.5 WATER HAMMER ARRESTORS: Furnish and install water hammer arrestors equal to Wade "Shokstops". Water hammer arrestors shall be sized in accordance with Plumbing and Drainage Institute Standard PDI-WH201 and American Society of Sanitary Engineering Standard ASSE-1010. Bellows and casing shall be constructed of stainless steel. Maximum working pressure shall be 250 PSIG. Temperature range shall be from -100° F to +300° F.

PART 3 - EXECUTION

3.1 FIXTURES:

- A. All fixtures subject to damage prior to completion of building shall be protected in an approved manner. Job must be turned over to Owner with all fixtures clean and free from damage.
- B. Unless specifically specified to be furnished with chair carrier, wall hung lavatories, sinks, etc., shall be secured to wall with back-up plate and threaded rods. The Contractor shall furnish and install all backing, reinforcing, hangers, bolts, anchors and brackets required.
- C. Fixtures shall be installed in accordance with manufactures recommendation. Fixtures mounted on uneven surfaces shall be bedded in an approved manner.

3.2 FREEZE RESISTANT DRINKING FOUNTAIN: Unit shall have pneumatic operated valves and shall be installed below frost line to drain water to non-freezing depth. Five (5) cubic feet of porous gravel fill shall be required for water left in supply line between valve and bubbler when valve is in off position to drain through check valve into ground.

3.3 CLEANOUTS:

- A. Cleanouts shall be provided at the ends and at points in change of direction of all drain, soil, waste pipes and branches thereof, at the foot of each riser, at all offsets, in all horizontal runs at approximately 50' intervals, and at other points where indicated on plans or where required.
- B. All cleanouts in connection with cast iron pipes, except the traps and fittings on horizontal branches, shall have tapped "Y" fittings of same size as pipe up to 4", and 4" for all larger pipe, closed with screw plugs. All other cleanouts in connection with cast iron pipe, except those that occur in finished floors and walls shall have heavy cast iron ferrules same sizes as pipe up to 4", and 4" for all larger pipe, caulked into hub, and closed with a screw plug.

- 3.4 FLOOR DRAINS: Install floor drains for area drainage use flush and level with finish floor. Install floor drains used in shower pans with clamping collar above floor elevation and strainer at tile elevation.
- 3.5 WATER HAMMER ARRESTORS: Install shock absorbers as indicated on Drawings or as a minimum at each hot and cold line drop to fixture batteries. Shock absorbers shall be sized as recommended by the manufacturer.

END OF SECTION 15400

SECTION 15500 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL

- 1.1 SCOPE: Work shall include all necessary parts, equipment and labor to provide a complete wet fire protection system as specified and shown on the drawings. Design and installation shall comply to the requirements of NFPA, IBC, FM, and OSHA. The specifications and drawings set minimum performance and provide a guide for the Contractor to design and layout the sprinkler system. The Contractor shall verify design flows and conditions with the local authority having jurisdiction for the purposes of bidding and designing the sprinkler system. All applicable codes and NFPA standards shall be followed. In the event that a code conflict occurs, the most stringent requirement shall apply. The sprinkler system shall be hydraulically calculated as per NFPA and FM. Each system shall have a minimum safety factor of 10 PSI. EXCEPTION: Standpipe calculations to be provided as per local authority having jurisdiction requirements. Velocity for under ground piping shall comply to the requirements of NFPA and FM. Provide pressure-reducing devices or pressure restricting devices on all valves as required by NFPA, FM, and IBC. Fire sprinkler contractor shall pay for all permits, fees, licenses, patents and certificates of approval.
- 1.2 QUALITY ASSURANCE: All work shall be done in accordance with Owner's insurance carrier's requirements, NFPA requirements and all applicable local and state codes and ordinances. The sprinkler system designer shall have obtained NICET Level 3 certification in fire sprinkler design prior to designing the system(s). The contractor shall be licensed to perform fire protection work within State of Arkansas as per the requirements of the Arkansas Fire Protection Licensing Board. Equipment specified herein shall be as noted or equivalent. The sprinkler Contractor shall coordinate with other trades on the job in locating the sprinkler system in relation to lights, steel framing, building HVAC system, etc. The Contractor shall, after completion of the work, make any corrections to the system as required for approval by the insurance carrier, the Engineer and the local authority having jurisdiction. In order to expedite sprinkler system design and upon mutual agreement, Insight Engineering may assist sprinkler contractor in the development of "working plans". However, the sprinkler contractor shall satisfy all code, fabrication, coordination, and AHJ requirements.
- 1.3 SUBMITTALS:
- A. Submit shop drawings on all equipment, hydraulic calculations and detailed drawings on the proposed system to the Architect through the general contractor and to the local authority having jurisdiction for approval.
 - B. Submit plans and hydraulic calculations as per the requirements of NFPA 13. The sprinkler contractor shall be required to receive reviewed and approved drawings from all AHJ prior to commencing fabrication or installation. Partial submittals are not acceptable.

- C. Coordinate the index sheet of the material submittal to coincide with the arrangement of the product specification order as shown in this division. This will expedite the review process.
- 1.4 COORDINATION: All work shall be designed and installed in accordance with the local utility company requirements. Contractor shall submit plans and specifications to all AHJ and receive approval prior to installation. Failure to receive approval prior to installation, see quality assurance section.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION PIPING AND FITTINGS:

- A. Above ground fire protection wet piping shall be Schedule 10 roll grooved black steel meeting all NFPA 13 and Factory Mutual requirements or Schedule 40 threaded or groove black steel meeting all NFPA 13 and Factory Mutual requirements. Above ground fire protection dry, deluge, and pre-action piping shall be Schedule 10 roll grooved galvanized steel meeting all NFPA 13 and Factory Mutual requirements or Schedule 40 threaded or groove galvanized steel meeting all NFPA 13 and Factory Mutual requirements. All pipe end preparations shall meet the requirements of NFPA 13.
- B. Flange fittings around the fire pump shall be standard class 125 cast iron on the pump suction or extra heavy class 250 (if required by pump discharge pressure) cast iron on the pump discharge. Black grade groove fittings and couplings for wet systems and galvanized for dry, deluge, and pre-action systems shall be installed. All groove couplings shall be UL / FM approved for 500 PSI working pressure. The use of groove reducing couplings with a maximum working pressure of 350 psi is acceptable on wet systems only. Groove couplings installed on all dry systems and pre-action systems shall utilize the "flush seal" type gaskets. Fittings and couplings for screwed pipe shall be standard class cast iron 125. No groove fitting that has a "short" take out nor the accompanying coupling, will be acceptable. No press-fit or sock it type fittings will be acceptable. All groove fittings to be of the same manufacturer. Installer is cautioned to NOT mismatch groove material. Welded outlets on piping shall comply the requirements of ANSI B1.20.1; ASTM A-53, Grades A or B, Type E. Welded outlets to be UL listed, FM approved for use conforming to NFPA. NOTE: The outlet type used shall match the pipe type installed. For example, a Schedule 40 pipe shall have a Schedule 40 welded outlet and a Schedule 10 pipe shall have a Schedule 10 outlet. Segment welded fittings are not acceptable.
- C. Underground fire protection and lead in piping shall be ductile iron class 50, 51, or 52 conforming to the latest revision of ANSI / AWWA C151 / A21.51. Pipe shall have standard asphaltic coating on the exterior. Pipe shall also have a cement-mortar lining on the interior in accordance with ANSI / AWWA C104 / A21.4, of latest revision. Install pipe as specifically required by the manufacturer, NFPA 24, and all AHJ. Consult local AHJ for underground material, means, and methods.

- D. Underground fittings shall be cement lined ductile iron mechanical joint conforming to ANSI / AWWA C104 A21.4 of latest revision. Install fittings as specifically required by the manufacturer, NFPA 24, and all AHJ.
- E. CPVC Piping: Shall be equivalent to Tyco Fire Products "BLAZEMASTER" manufactured as per ASTM F-442, SDR 13.5. Design and installation of piping to be in strict accordance to the specifications of the manufacturer and NFPA.
- F. CPVC Fitting: Shall be equivalent to Tyco Fire Products "BLAZEMASTER" manufactured as per ASTM F-438, for Schedule 40 and ASTM F-439 for Schedule 80. Design and installation of piping to be in strict accordance to the specifications of the manufacturer and NFPA.
- G. Copper tubing having a wall thickness of Type K shall be used from a point of approximately 1'-0" outside the MRI Room. The sprinkler contractor shall penetrate the RF shield one (1) time by use of the wave guide provided by the MRI manufacturer and install Type K copper throughout the MRI Room for the fire sprinkler system.
- H. Copper fittings conforming to ASME B16.18 shall be provided for copper tube connections. This is a cast copper alloy solder joint pressure fitting.

2.2 VALVES:

- A. Gate Valve (above grade): Valves 2" and smaller shall be made of the best grade brass of screwed pattern, solid wedge disc, outside, screw and yoke, screwed bonnet and malleable iron wheel, Nibco T-104-O 175 lb. non-shock or approved equivalent.
- B. Flange End O. S. & Y. Gate Valves: Valves 2-1/2 " and larger shall be cast iron body, cast iron wheel, bolted bonnet, outside screw-and-yoke, solid wedge disk, parallel seat, Nibco F-607-OTS 175 lb. non-shock or approved equivalent. All valves shall have UL / FM approval stamped on valve.
- C. Non-Rising Stem Gate Valves: Valves shall be equivalent to Nibco F-609 or M-609. UL / FM / ULC approved, cast iron body, bolted bonnet, solid wedge disk, and parallel seat.
- D. Indicator Post: Shall be of the same manufacturer as the non-rising stem gate valve. Post shall be equivalent to Nibco NIP-2AJ wall post or Nibco NIP-1AJ upright post. Indicator post to be UL / FM / ULC approved, body of ductile iron, with steel operation rod, bronze stem, and cast aluminum target plates ("open" and "shut").
- E. Groove End Butterfly Valves: Valves shall be equivalent to Tyco Fire Products Model BFV-1 with built in tamper switch. Maximum working pressure 300 PSI, UL / FM / ULC approved, and ductile iron body having epoxy coating. Ductile iron disk, disk seal of grade EPDM type E encapsulated rubber conforming to ASTM D-2000. Both upper stem, lower plug, and stem to be stainless steel.

- F. Groove End Check Valves: Valves shall be equivalent to Tyco Fire Products Model CV-1F. Maximum working pressure 300 PSI, UL / FM / ULC approved, ductile iron body and cap with stainless steel clapper.
- G. Screw Check Valves: Valves 2" and smaller shall be UL / FM approved made of brass, screwed pattern, horizontal swing, Y-pattern, renewable composition disc, equivalent to Nibco KT-403-W, 200 lb. WOG non-shock.
- H. Flange End Check Valves: Valves 2-1/2" and larger shall be UL / FM approved horizontal swing, iron body, bronze trim, bolted bonnet, bronze disc, flanged ends, equivalent to Nibco F-968-B, 250 lb non-shock.
- I. Globe Valves and Angle Valves: Valves shall be UL / FM approved made of brass, screwed pattern, EPDM type W disk, screwed bonnet, and aluminum wheel, Nibco KT-211-W-UL or KT-67HL 175 lb. WOG non-shock or approved equivalent.
- J. Dry Pipe Valves: Valves 4" and 6" shall be equivalent to Reliable Model D. UL / FM / ULC approved with working pressure pf 175 PSI, flange to mate with ANSI B 16.1 flange and groove per ANSI / AWWA C606. Install Reliable Model D galvanized trim kit, which is to incorporate an electric sprinkler alarm switch.
- K. Alarm Check Valves: Valves shall be equivalent to Reliable Model E with Model E-3 variable pressure trim set and Model E-1 retard chamber. For grid systems provide a pressure relief kit.
- L. Pressure Regulating Valves for Sprinkler Systems: Guardian Series 9500 floor control and test module to be installed on sprinkler systems exceeding 175 psi at the inlet side of the valve.

2.3 FIRE DEPARTMENT AND HOSE EQUIPMENT:

- A. Class I Fire Department Valve Cabinet: Potter-Roemer, Inc. Fig. 1830, 10" Deep, 20 gauge recessed painted steel box, 20 gauge tubular steel full glass door with 20 gauge frame, continuous steel hinge, and brass pin. Steel corner seams welded and ground smooth. Include Potter-Roemer, Inc. Fig. 4065 2-1/2" fire department valve rough brass finish with 2-1/2" x 1-1/2" reducer with cap and chain. Hose connection shall match responding fire department requirements.
- B. Fire Department Valve: Globe Valve, Potter-Roemer, Inc. Fig. 4115 2-1/2" rough brass with cap and chain. Hose connection shall match responding fire department requirements.
- C. Exposed Fire Department Connection: Potter-Roemer, Inc. Fig. 5751-D, polished chrome plated 4 x 2-1/2 x 2-1/2 cast brass two-way inlet body with drop clappers, pin lug swivels, plugs, and chains. Polished chrome plated cast brass wall plate with proper lettering.

- 2.4 FIRE HYDRANT: Mueller Super Centurion 200 A-423 “pumper” style three way hydrant. Furnished with 6” mechanical joint inlet. Working pressure 250 PSI, 500 test pressure compression type main valve. Provide bury length as site conditions require and allow hose connections to be placed at not less than 24” above finished grade and not more than 36” above finished grade.
- 2.5 DOUBLE CHECK DETECTOR ASSEMBLY: Shall consist of two (2) independently acting check valves, two (2) resilient seated outside stem and yoke gate valves and four (4) test cocks together with a by-pass that includes a water meter and reduced pressure backflow preventor. Valve bodies and cover shall be manufactured of ductile iron ASTM A536, Grade 65-45 12. Ductile iron bodies shall be flanged, ANSI B16.1, Class 125 epoxy coated. Assembly must be factory assembled and backflow tested. The assembly shall be constructed so all internal parts can be serviced from the top, side, or removed while assembly is in line. The assembly shall be rated 175 MWWP (32° - 140° F).
- 2.6 REDUCED PRESSURE ZONE ASSEMBLY: A Reduced Pressure Zone Assembly shall be installed at each cross-connection to prevent backsiphonage and backpressure of hazardous materials into the potable water supply. The assembly shall consist of a pressure differential relief valve located in a zone between two (2) positive seating cam-check assemblies. The main valve body shall be manufactured from 300 Series stainless steel for corrosion resistance. The cam-check assembly shall be of thermoplastic construction with stainless steel hinge pins, cam arm, and cam bearing. The cam-check assembly shall utilize a single torsion spring design to minimize pressure drop through the assembly. The cam-check assembly shall be modular and shall seal to the main valve body by the use of an O-ring. There shall be no brass or bronze parts used within the check assembly or relief valve. The use of seat screws to retain the check valve seat is prohibited. All internal parts shall be accessible through a single cover on the valve assembly securely held in place by a two-bolt grooved coupling. The differential relief valve shall be of stainless steel construction and shall utilize a rolling diaphragm and no sliding seals. The relief valve shall be bottom mounted and supplied with a steel reinforced sensing hose. The assembly shall include two (2) resilient seated shutoff valves and four (4) ball type test cocks. The assembly shall be an Ames Company Series 4000SS.
- 2.7 VALVE ENCLOSURE:
- A. As manufactured by Aqua Shield or equivalent.
 - B. Material for panels shall be 5032-H32 aluminum (0.050 / 18 gauge) and shall comply with ASTM B209. The aluminum shall have a standard mill finish.
 - C. Insulation shall be a closed cell polyisocyanurate foam core laminated to heavy, black glass fiber reinforced facers each side, the insulation shall have the following property’s:
 - 1) R-Value – 10

- 2) Dimension stability – 2 % linear change
- 3) Compressive strength – 20 PSI and 25 PSI
- 4) Product density – normal 2.0 PCF
- 5) Water absorption – <1 % by volume
- 6) Service temperature – -100° F to + 250° F
- 7) Moisture vapor transmission – <1 Perm
- 8) Flame spread – 25
- 9) Thickness – 1.5”

- D. Adhesive shall be Hilti brand product CA-3200.
- E. The exterior of the panels shall have a protective PVC masking to protect finish before assembly. The protective masking shall be removed before assembly of the enclosure.
- F. Access panels shall have factory installed locks with master keys provided.
- G. Heating equipment shall be designed and provided by the manufacturer to maintain a minimum internal temperature of 40° F with the external temperature of -34° F. There shall be one (1) 1000W / 120V / 1PH heater thermostatically controlled.
- H. Enclosure shall be assembled plumb and square on a concrete pad as per manufacturers provided instructions.

2.8 SWITCHES AND DEVICES:

- A. OS&Y Tamper Switches: Switches equivalent to System Sensor Model OS&Y 2. Two (2) sets of SPDT (form C) contacts; 10.0A @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- B. PIV Tamper Switches: Switches equivalent to System Sensor Model PIBV2. Two (2) sets of SPDT (form C) contacts; 10.0A @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- C. Flow Switches: Switches equivalent to System Sensor WFD series. Two (2) sets of SPDT (form C); 10.0A, 1/2 HP @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range 32 F to 120 F.
- D. Pressure Switches: Switches equivalent to System Sensor Model EPS10-2. Two (2) sets of SPDT (form C); 10.0A, 1/2 HP @ 125/250 VAC; 2.5A @ 6/12/24 VDC. Operating temperature range -40 F to 160 F.

- E. Test and Drain: Test and drain equivalent to AGF Model 1000. UL / FM / ULC approved device, which shall be piped to suitable drainpipe.
- F. Riser Manifold: Riser manifold equivalent to Tyco Fire Products Fig. 513, 513D, 513R. Working pressure is 175 PSI equipped with; water flow switch, ball valve, test and drain, valve with properly sized test orifice, and sight glass. Provide optional pressure relief valve for grid system installation.

2.9 SPRINKLERS:

- A. All sprinklers for Light Hazard and all standard spray sprinklers for Ordinary Hazard shall be quick response.
- B. All sprinklers placed in finished ceilings shall be white finish with white recessed escutcheons, unless otherwise noted on the fire protection plans.
- C. All sprinklers shall be UL approved for the designed location and use.
- D. Temperature ratings of sprinklers based on distances from heat sources shall comply with the specific table in NFPA 13. It is NOT acceptable to provide higher “rated” sprinklers throughout a room, compartment, or area unless specifically required to do so by NFPA 13.
- E. Sprinkler head locations for 2’ x 4’ (or similar) acoustical tile lay in ceiling panel shall be designed to hit a place anywhere in the tile which is no closer than 9” to the tee bar. It is preferred that the sprinklers hit the quarter points of the tile however, in order to limit the sprinkler head count the above is acceptable. For 2’ x 2’ tiles sprinklers shall be no closer than 9” to the tee bar. It is preferred that the sprinklers hit the centerline of the tile however, in order to limit the sprinkler head count the above is acceptable. NOTE: This is a not a requirement for “return bends” to be installed to hit specific locations. This requirement is not in force for non-public small rooms such as toilets, janitor closets, storage rooms, kitchens or the like. In these rooms sprinklers shall be installed at no closer than 6” to ceiling tee bars.
- F. Sprinkler head locations for 2’ x 2’, and 2’ x 4’ (or similar) acoustical tile lay in ceiling panel shall be installed at the centerline of the tile. NOTE: This is a requirement for “return bends” to be installed to hit specific locations. See plan for areas or rooms which apply. This requirement is not in force for non-public small rooms such as toilets, janitor closets, storage rooms, kitchens or the like. In these rooms, sprinklers shall be installed at no closer than 6” to ceiling tee bars.
- G. Provide compatible sprinkler head guards for all pendent and upright sprinklers when the sprinkler deflector is installed below 7’ AFF.

2.10 HANGERS: All hangers shall be UL / FM approved.

- A. CPVC Pipe Hangers: Hangers shall be designed and installed as per the requirements of the manufacturer and NFPA. No hanger component shall be

allowed to come in contact with CPVC pipe unless that component is specifically listed for that contact.

- B. Contractor is cautioned to consider hanger locations when system pressure exceeds 100 PSI.
- C. Provide seismic bracing / restraints and the accompanying calculations as required by the building code in force. All seismic appurtenances shall comply with NFPA #13. Seismic bracing / restraints are required on this project.

PART 3 - EXECUTION

- 3.1 **INSTALLATION:** Install fire protection system in accordance to OSHA, NFPA, and local codes regulations and manufacturers recommendations. Refer to the drawings for a description of areas to be sprinklered and types of hazard. All fire protection piping shall be designed and installed after coordination with all other trades that may conflict with sprinkler routing. Coordinate location of sprinkler heads with Architect's reflected ceiling plan, lighting layout, and HVAC diffuser layout. In exterior vestibules, other outside entrance areas, and exterior type stairwells, install dry type sprinklers.
- 3.2 **FIRESTOPPING:** All pipe penetrations of rated partitions shall be properly caulked with fire caulking including sidewall sprinkler heads penetrating such partitions.
- 3.3 **SPARE PARTS / SIGNAGE:**
 - A. Provide and install all required signage on sprinkler system equipment, pipe, control valves, devices, and auxiliary drain valves as per NFPA #13.
 - B. Provide system tag at each system control valve. Each tag to be self-indicative of the area controlled by that valve.
 - C. Provide appropriate count sprinkler head cabinet with proportionate number of sprinklers and at least one sprinkler wrench for each type sprinkler installed on site. Locate the head cabinet as per owner's directive.
- 3.4 **CLEANUP:**
 - A. Special care shall be taken at all times but especially during "finish out" stage while using the pipe cutting / threading machine. Provide protection below power machine to prevent drips and spills of cutting oil.
 - B. All exposed finished surfaces shall be wiped clean of smudges, fingerprints, etc..
 - C. Sprinkler contractor is specifically responsible for removal of all debris created as a direct or indirect result of his portion of the construction project.

- 3.5 CLOSE OUT: Before application for final payment is requested the contractor is to provide all requirements set forth by the General Conditions of the Specifications and deliver to the engineer of record (Insight Engineering) the following:
- A. One (1) full set of "AS BUILT" drawings. Provide "DBX As Built Drawings" cabinet, size D, by Space Age Electronics. Field locate cabinet adjacent to fire riser.
 - B. One (1) full set of Operating and Maintenance Manuals.
 - C. One (1) full set of applicable and executed test certificates for each system.
 - D. One (1) full set of electronic files (.dwg format) containing all fire protection shop drawings used in the performance of the contract. These files shall match the "AS BUILT" drawings stated in Section A above.
 - E. On site training of owner specified personnel shall be coordinated through the General Contractor. Training session(s) shall be provided in order to familiarize the owner with the various operations of the systems installed. The sprinkler contractor shall direct and illustrate to the owner the function of the various sprinkler valves in his facility. The sprinkler contractor is to show the owner the location of all control valves and drain valves as well as illustrate these valves specifically. Upon completion of the training session the sprinkler contractor shall provide a letter to the owner for his signature containing the content of the training session. This letter shall be forwarded to the engineer of record (Insight Engineering).

END OF SECTION 15500

SECTION 15600 - HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE:

- A. Extent of heating, ventilating and air conditioning (herein after referred to as HVAC) equipment is indicated by drawings and schedules, and by requirements of this section.
- B. Types of equipment required for the project include, but is not limited to, the following:
 - 1) Unit Heaters
 - 2) Gas Fired Furnaces
 - 3) Split System Condensing Units
 - 4) Filters (30, 60, 90 and 99.97 % efficiency)
 - 5) Supply, Exhaust and Ventilation Fans

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS:

- A. Vibration isolation and flexible connectors for HVAC equipment; Section 15200.
- B. Insulation of HVAC equipment; Section 15250.
- C. Air distribution equipment, Boiler venting; Section 15800.
- D. Control work required in conjunction with HVAC equipment; Section 15900.
- E. Air and water side balancing; Section 15990.
- F. Motor starters, disconnects, power wiring of HVAC equipment and variable frequency drives; Division 16.

1.3 QUALITY ASSURANCE:

- A. AFBMA Standards: Load Ratings and Fatigue Life for Ball Bearings. Bearings must have an L10 life of not less than 200,000 hours for air handling units and utility vent sets, and an L50 life of not less than 200,000 hours for in-line and rooftop exhaust fans.
- B. AGA Standards: Boilers shall be tested, listed and certified in accordance with the requirements of the American Gas Association Laboratories and ANSI Standard Z31.13.

- C. AMCA Standards: Comply with Air Movement and Control Association (AMCA) standards as applicable to testing and rating fans (AMCA 300), air moving devices (AMCA 301) and testing of louvers, dampers and shutters.
- D. ANSI / ASHRAE Standards: Comply with ANSI / ASHRAE Standard 15 - Safety Code for Mechanical Refrigeration. Provide central station packaged air handling units which comply with ANSI Standard 430.
- E. ARI Certification: Provide central station packaged air handling units which comply with Air-Conditioning and Refrigeration Institute (ARI) Standard 410. Provide chillers which comply with ARI Standard 550.
- F. ARI / ASHRAE Standards: Heat Recovery Wheels shall be tested in accordance with the requirements of ASHRAE Standard 84 / ARI Standard 1060.
- G. ASHRAE Standards: Comply with ASHRAE Standard 52-76 as applicable to air filter efficiencies.
- H. ASME Code Compliance: Construct boilers in accordance with ASME Boiler and Pressure Vessel Code, "Heating Boilers", Section IV. Construct heat transfer units in accordance with ASME Boiler and Pressure Vessel Code, Section VIII "Unfired Pressure Vessels", bearing the National Board stamp.
- I. ASTM (& UL) Compliance: Thermal insulation for equipment shall have the following maximum UL Fire Resistance Ratings, per ASTM Standard E84, unless otherwise specified:
 - a) Flame Spread: 25
 - b) Fuel Contributed: 50
 - c) Smoke Developed: 0
- J. NEMA (& IEEE) Compliance: Provide electric motors which meet the scheduled full load efficiency, as indicated on the drawings, per NEMA Standard MG1-12.53a, based on dynamometer testing per IEEE 12 Method B.
- K. NEMA (& UL) Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories (UL) and comply with NEMA standards.
- L. NFPA Compliance: Comply with applicable provisions of ANSI / NFPA 70 "National Electric Code", pertaining to construction and installation of electrically operated components of packaged air handling units. Install fuel gas piping in accordance with NFPA 54 "National Fuel Gas Code".
- M. TEMA Standard Compliance: Construct and install heat transfer units in accordance with "Standards of the Tubular Exchanger Manufacturers Association".

- N. UL Compliance: Comply with UL Standard 900 as applicable to listing of air filters. Comply with UL 984 - Safety Standards for Hermetic Motor Compressors.
 - O. All electronic equipment shall conform to the requirements of FCC Regulations, Part 15, Section 15, governing radio frequency and electromagnetic interference and shall be so labeled.
- 1.4 SUBMITTALS: Comply with Sections 01300 and 15000.
- A. General: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated (including fan and pump curves, tabular data etc.), weights and loadings (shipping, installed, and operating where applicable), construction materials furnished (including gages and finishes), required clearances, location and size of field connections, motor electrical characteristics and accessories. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed. Indicate equipment, piping and connections, valves, strainers, piping accessories required for a complete system. Submit suggested structural steel support, including dimensions, sizes and locations for mounting bolt holes. Include weight distribution drawings showing point loadings.
 - B. Provide data as described above for the following equipment:
 - 1) Unit Heaters
 - 2) Gas Fired Furnaces
 - 3) Split System Condensing Units
 - 4) Filters (30, 60, 90 and 99.97 % efficiency)
 - 5) Supply, Exhaust and Ventilation Fans
 - C. Air handling units: Submit manufacturer's capacities and ratings for fan and coils. A scale drawing, indicating overall dimensions, not less than 1/4" = 1' 0" scale will be required for all substituted airhandlers.
 - D. Any substitutions of specified HVAC equipment to be installed in a mechanical room will require revised plan and elevation drawings of each mechanical room where substitutions occur, in a scale not less than 1/4" = 1' 0". Drawings shall indicate equipment sizes, clearances and elevations, of ALL equipment (substituted and non-substituted). Failure to furnish revised mechanical room drawings with the substituted equipment submittal will result in rejection of the submission and no additional contract time will be allowed for delay of this cause.
 - E. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, construction details, and field connection details.

- F. Wiring Diagrams: Submit ladder-type wiring diagrams for electrically operated accessories. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - G. Electric Motors: All equipment specified with premium efficiency motors shall include data sheets, with equipment submittals, on motors. Data sheets shall include manufacture / model number of motor including statement motor complies with NEMA standard MG1 part 31.40.4.2.
 - H. Maintenance Data: Submit maintenance data, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists for each equipment item, including "trouble - shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.
- 1.5 DELIVERY, STORAGE AND HANDLING:
- A. Deliver HVAC equipment with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers. Factory assemble entire unit, where practical. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
 - B. Store HVAC equipment in clean dry place and protect from weather and construction traffic. Handle HVAC equipment carefully to avoid damage to components, enclosures, and finish. Leave factory shipping covers in place until installation. Do not install damaged components; replace and return damaged components to equipment manufacturer.
 - C. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

PART 2 - PRODUCTS

2.1

PART 3 - EXECUTION

- 3.1 INSPECTION: Examine areas and conditions under which HVAC equipment shall be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION (GENERAL): Install HVAC equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to insure that equipment complies with requirements and serves intended purposes. Install HVAC equipment with recommended clearances provided for service and maintenance.

- 3.3 ELECTRICAL CONNECTIONS: Ensure that HVAC equipment and components are wired properly, with rotation in direction indicated and intended for proper performance. Furnish to Electrical Installer, manufacturer's wiring diagram and electrical requirements for installation of field-wiring required for equipment (including control panels); not work of this section.
- 3.4 FIELD QUALITY CONTROL: Upon completion of installation of HVAC equipment, and after motors have been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.
- 3.5 INSTALLATION OF UNIT HEATERS:
- A. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
 - B. Install remote thermostat.
 - C. Gas Fired Unit Heaters:
 - 1) Extend gas piping and connect to unit, provide gas shutoff valve, 1/8" NPT plugged test connection, tee, and dirt pocket. Locate piping so as to not interfere with service of unit. Extend gas piping runout, full size of gas train inlet, from tee to gas train connection, provide union with sufficient clearance for unit removal and service.
 - 2) Install type B flue, storm collar and gravity vent cap for all gas fired equipment.
 - D. INSTALLATION OF GAS FURNACES:
 - E. Coordinate with other work, including ductwork and piping, as necessary to interface installation of packaged equipment with other work.
 - F. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
 - G. Extend gas piping and connect to unit, provide gas shutoff valve, 1/8" NPT plugged test connection, tee, and dirt pocket. Locate piping so as to not interfere with service of unit. Extend gas piping runout, full size of gas train inlet, from tee to gas train connection, provide union with sufficient clearance for unit removal and service.
 - H. Install type B flue, storm collar and gravity vent cap for all gas fired equipment.
 - I. Seal off area around return air plenums / furnace support frame.

- J. Install remote thermostat *and three (3) speed fan switch.*
- K. *Install Kenall Model TG-2 clear inflexible, injection molded Herculex thermostat covers with vandal proof screws.*

3.6 INSTALLATION OF CONDENSING UNITS:

- A. Install condensing unit on concrete pad and secure unit to pad with anchor bolts.
- B. *Install condensing unit on framing system and secure unit to pad with approved anchor devices.*
- C. Install all necessary refrigerant piping, fittings valves, etc., to provide a complete installation as indicated and as specified.
- D. Install the control devices furnished by the manufacturer, but not specified to be factory mounted in accordance with the manufacturer's instructions, complete with control wiring.

3.7 INSTALLATION OF DIRECT EXPANSION COOLING COILS:

- A. Install direct expansion cooling coil and all necessary refrigerant piping, fittings valves, etc., to provide a complete installation as indicated and as specified.
- B. Connect humidity condensate drain and route condensate piping to floor drain or as otherwise indicated on the drawings. Trap shall be adequately sized to properly drain condensate.

C. INSTALLATION OF FILTERS:

- D. Comply with applicable portions of ANSI / NFPA 70, 90A and B, pertaining to installation of air filters.

3.8 INSTALLATION OF CENTRIFUGAL PUMPS:

- A. Install pumps in accordance with manufacturer's instructions. Remove all bracing and blocking devices installed for shipment.
- B. Install base mounted pumps on concrete base with anchor bolts fastened into floor slab. Base shall be a minimum 4" high or as required for access and or clearance of piping devices such as strainers, suction diffusers, etc.
- C. Level and shim the unit base and grout to the concrete pad. Shim the driver and realign the pump and driver. Correct axial, angular or parallel misalignment of the shafts. Connect properly aligned and independently supported piping. Recheck alignment.

- D. *Install pumps on concrete inertia pads or on concrete pads with anchor bolts poured in place as indicated on the drawings. Set and level pump, grout under pump base with non-shrink grout.*
- E. Provide piping; accessories; hangers, supports, and anchors; valves; meters and pressure gauges; vibration isolation; and equipment supports; as indicated on the drawings for complete installation.
- F. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.
- G. Verify that the piping system has been flushed, cleaned and filled. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition. After several days operation, remove the disposable start-up strainer in the suction diffuser.
- H. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

3.9 INSTALLATION OF FANS:

- A. Coordinate with other work, including ductwork, floor construction, roof, wall, ceiling, and electrical work as necessary to interface installation of air handling equipment with other work.
- B. Hang units from structure, where required, using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level. Install vibration isolation devices as furnished with the unit or specified in Section 15200.
- C. Install all accessories, shipped loose such as roof curbs, speed controls, motorized dampers, shutters, vibration isolators, etc.
- D. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, bearings lubricated, and fan has been test run under observation.
- E. Electrical: Furnish electrical field-wiring diagrams to Electrical Contractor for power wiring of fan motor and motorized damper.

3.10 EXTRA STOCK:

- A. Provide one (1) spare set of belts for each different size or type required for the air handling units and exhaust fans.
- B. Filters used during construction shall be replaced for testing and balancing. The airhandler shall be furnished with clean filters at acceptance of project. Spare filters shall be turned over to the Owner.

JONESBORO MUNICIPAL AIRPORT
MAINTENANCE HANGAR RECONSTRUCTION

FEBRUARY 2021
CONSTRUCTION SET

END OF SECTION 15600

SECTION 15800 AIR DISTRIBUTION

PART 1 – GENERAL

- 1.1 SCOPE: Provide air distribution, complete, including ductwork, grilles, dampers and ductwork accessories.
- A. Ductwork System:
- 1) Low Pressure Ductwork: Defined as ductwork subjected to velocities of 2000 fpm or less, and operating pressure of 2" w.g. or less, positive or negative.
- B. Ductwork Accessories: Manual control dampers, duct hardware, duct access doors, flexible connections, and miscellaneous components.
- C. Grilles and Registers
- 1.2 RELATED WORK:
- A. Refer to Section 15250 for external insulation required in conjunction with ductwork; not work of this section.
- B. Refer to Section 15990 for balancing of air distribution devices; not work of this section.
- 1.3 QUALITY ASSURANCE:
- A. Installer: A firm with at least five (5) years of successful installation experience on projects with ductwork systems work similar to this project.
- B. Standards: Comply with SMACNA Duct Construction Standards (Low Pressure) - latest editions as of date of issue of these specifications.
- C. UL Compliance: Furnish labeled fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".
- D. NFPA Compliance: Comply with the latest editions of ANSI / NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI / NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
- 1.4 SUBMITTALS: Comply with Section 15000.
- A. Product Data:
- 1) Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork, used for work of this section.
 - 2) Submit manufacturer's air treatment equipment specifications and installation instructions including, but not limited to, dimensions, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, and fire classification.
 - 3) Submit manufacturer's data on diffusers and grilles, including the following:
 - a) Schedule of diffusers and grilles indicating drawing designation, room location, number furnished, model number, size and accessories furnished.
 - b) Data sheet for each type of diffuser and grille, and accessory furnished; indicating construction, finish and mounting details.

- c) Performance data for each type of diffuser and grille furnished, including airflow capacity, throw and drop, and noise criteria ratings. Indicate selections on data.
 - 4) Submit manufacturer's specifications for each type of duct accessory, including dimensions, capacities, and materials of construction; and installation instructions.
 - B. Shop Drawings: Submit dimensioned layouts of ductwork where required in the plans and specifications showing both the accurately scaled ductwork and its relation to space enclosure. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.
 - C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory, include this data in Maintenance Manual.
- 1.5 DELIVERY, STORAGE AND HANDLING:
- A. Protect fabricated ductwork, accessories and associated products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
 - B. Deliver diffusers and grilles wrapped in factory-fabricated fiberboard containers. Identify on outside of container, type of diffuser or grille and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- 1.6 Where possible, store air distribution and treatment products inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 – PRODUCTS

2.1 DUCTWORK MATERIALS:

- A. Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI / ASTM A 527, lockforming quality, with ANSI / ASTM A 526, G 90 zinc coating; mill phosphatized for exposed locations. Galvanized sheet steel shall be equal to Armco, Toncan or Youngstown.

2.2 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Furnish and install miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size necessary to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Low Pressure Duct Sealant: Furnish and install non-hardening, non-migrating mastic equal to "Hardcast" FTA-20 with DT tape.
- C. Ductwork Support Materials (Galvanized): Furnish and install hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- D. Aluminum Foil Tape: Furnish and install 3" width (minimum) aluminum tape equal to Hardcast "Foil Grip". Tape shall have 15 mils of elastomeric modified butyl adhesive on 2 mil foil backing. Tape shall comply with UL 181B-FX.

2.3 LOW PRESSURE DUCTWORK FABRICATION:

- A. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "Duct Construction Standards" (Low Pressure) latest edition, and as indicated on drawings.
- B. Furnish and install shop fabricated ductwork in 4,8,10 or 12 foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to the greatest extent possible, so as to minimize field assembly of systems. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
- C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
- D. Flexible Air Duct (Low Pressure): Furnish and install pre-insulated flexible air duct on air duct systems as shown on drawings. Duct shall be Technaflex Type MKE or approved equal. Duct shall be listed and labeled by Underwriters Laboratories, Inc. as a Class 1 air duct, Standard 181. Duct shall comply with NFPA 90A and 90B. Duct shall be rated for six inches w.c. positive pressure and 1" w.c. negative pressure and shall be rated for 4000 fpm. Duct shall consist of galvanized wire helix permanently bonded and enclosed in a polyester film and then covered with 1-1/2" thick, 3/4 pcf density fiberglass insulation sheathed in a vapor barrier of aluminum metalized polyester film laminated to glass mesh elastomer backed coated barrier. Vinyl or non-aluminized barriers will NOT be allowed. Maximum runout shall not exceed 8 ft. Minimum run out length shall not be less than 5 ft. Insulated flexible duct work shall be factory labeled at intervals not greater than 36 inches with the name of the manufacturer, the nominal thickness and density of the insulation or R-value and the flamespread and smoke developed ratings of the composite materials.

2.4 DUCTWORK ACCESSORIES:

- A. Duct Hardware:
 - 1) Manual Damper Operator:
 - a) Accessible Ceilings: Furnish and install for each damper, splitter vane, or extractor, a quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
 - b) Inaccessible Ceilings: Provide a field fabricated bracket, miter gear operator equal to Young No. 914, couplings, shafts, and damper regulator (equal to Young No. 1) for each designated damper. Refer to the drawings.
 - 2) Where damper or splitter control rods extend through finished walls or ceiling, Contractor shall terminate rods in approved access box equal to a Young No. 1 surface mounted quadrant regulator.
 - 3) All splitter rods shall be provided with Young No. 656 - 3/8" or 659 - 1/2" end bearings using two (2) bearings per splitter damper.
- B. Flexible Connections: Furnish and install 30 oz. woven glass fabric, double coated with Neoprene "Ventglas", or equal, flexible connections to give no less than 3" clear break between metals joined, where indicated or required.

C. Branch Fittings: Provide take off fittings manufactured with airtight seams using a locking double seam. Units shall be constructed of 26 gage galvanized steel (minimum). Units shall have a factory installed volume damper with locking spring loaded quadrant. Damper regulator shall be elevated 2" to allow for insulation thickness. Fitting shall be conical type as described on the plans with a base mounting flange secured by a minimum of four sheet metal screws or pop-rivets. See drawings for alternate "Streamline" branch take-off fittings.

D. Manual Balancing Damper:

- 1) Low Velocity (Under 12" High): Furnish and install low velocity manual dampers equal to United Air Model EGS. Damper shall have 2" x 14 gage galvanized steel frame, 18 gage galvanized steel blade, 1/4" square plated steel control shaft and plated locking hand operator quadrant.
- 2) Low Velocity: Furnish and install low velocity manual dampers equal to American Warming and Ventilating Model VC-15 Opposed Blade Damper. Frames shall be 3-1/2" x 1" x 16 gage galvanized steel hat channels. Blades shall be 16 gage galvanized steel with 7-1/4" width. Axles shall be 1/2" diameter galvanized steel stub. Bearings shall be heavy duty molded self-lubricating nylon.

2.5 GRILLES AND REGISTERS:

A. General:

- 1) Furnish and install manufacturer's standard diffusers and grilles where shown or required. Diffusers and grilles shall be of size, shape, capacity and type indicated, and constructed of materials and components as indicated, as required for complete installation.
- 2) Performance: Provide diffusers and grilles that have, as minimum, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

2.6 Air distribution devices have been specifically selected based on Titus's performance data. If devices are submitted, other than those specified, the submittal must include an item by item selection of substitutions listed by space location. The list must include model number, size, air pattern, airflow, pressure drop, throw, NC noise level, finish and mounting method for both the submitted and specified device. Where compliance with performance requires different dimensions, such as neck or face size, than the specified item, the submittal must note where these dimension changes occur listing both the original and new dimensions.

PART 3 – EXECUTION

3.1 DUCTWORK FABRICATION:

A. General:

- 1) Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, air terminals, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions,

which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

- 2) Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
- 3) Install duct hangers and supports in accordance with SMACNA Standards, Section IV.

B. Sheet Metal (Low Pressure):

- 1) Sheet metal shall be fabricated reasonably air tight and light proof and shall be free of vibration and sag. Pittsburgh Lock Machine, if used, shall be kept in first class working order with rollers properly maintained so that no excessive peeling off of galvanized coating on metal will occur.
- 2) Sheet metal gages, reinforcing joints, seams, etc., shall be as called for in the latest edition of Sheet Metal and Air Conditioning Contractors National Associates, Inc., (SMACNA) "Duct Construction Standards" (Low Pressure).
- 3) Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.
- 4) All elbows shall have a throat radius equal to the width of the duct wherever possible. Turning vanes shall be installed in all square elbows. Horizontal ducts over 400 square inches in cross-sectional area shall be supported from overhead structure members by $\frac{3}{4}$ " x $\frac{1}{8}$ " strap iron. Horizontal ducts under 400 square inches in cross-sectional area shall be supported from overhead structure with the use of 1" wide 18-gage galvanized metal straps.
- 5) Seal all joints in rectangular supply, return, exhaust and outside air ductwork with "Hardcast" Type DT sealing tape and Type FTA adhesive, installed in strict accordance with manufacturer's instructions. Clean all dirt, oil, moisture, etc., from surfaces before applying adhesive.
- 6) Low pressure round ductwork shall be constructed and installed where shown on the plans. Ducts shall be constructed as called for in the latest edition of SMACNA "Duct Construction Standards" (Low Pressure). Longitudinal seams shall be Acme lock grooved seam type and joints shall be crimp and bead type. In lieu of crimp and bead joints, cement all seams, join with sheet metal screws and wrap duct tape over screws and cement.
- 7) Joining and Attaching Flexible Duct:
 - a) Collars to which flexible duct is attached shall be a minimum of 2" in length. Sleeves used for joining two sections of flexible duct shall be a minimum of 4" in length.
 - b) Collars and sleeves shall be inserted into flexible duct a minimum of 1" before fastening.
 - c) Non metallic flexible duct shall be secured to the sleeve or collar with a draw band. If the duct collar exceeds 12" in diameter the draw band must be

positioned behind a bead on the metal collar. One complete wrap of 3" wide aluminum tape shall be applied over draw band.

- d) Insulation and vapor barriers on factory fabricated flexible ducts shall be fitted over the core connection and shall also be secured with a draw band. One complete wrap of 3" wide aluminum tape equal to Hardcast "Foil Grip" shall be applied over draw band and at the connection between the insulation of the flexible duct and the insulation of the metal duct.
 - e) All flex duct connections shall be installed to ADC Standards and sealed to UL 181 standards per AMC 603 and 604.2.1
- 8) Supporting Flexible Duct:
- a) Flexible ducts shall be supported at the manufacturer's recommended intervals but at least every 10'. Maximum permissible sag shall be 1/2 inch per foot of spacing between supports. A connection to another duct or to equipment shall be considered a support point. Hangers shall be adequately attached to the building structure.
 - b) Hanger or saddle material in contact with the flexible duct shall be wide enough so that it does not reduce the internal diameter of the duct when the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1-1/2" wide. Narrower hanger material may be used in conjunction with a sheet metal saddle that meets this specification. This saddle must cover one-half the circumference of the outside diameter of the flexible duct and fit neatly around the lower half of the duct's outer circumference.
 - c) To avoid tearing the vapor barrier, do not support the entire weight of the flexible duct on any one hanger during installation. Avoid contacting the flexible duct with sharp edges of the hanger material. Damage to the vapor barrier may be repaired with 3" wide aluminum tape equal to Hardcast "Foil Grip". If the internal core is penetrated, replace the flexible duct.

3.2 CLEANING AND PROTECTION:

A. Ductwork:

- 1) Clean ductwork internally, section by section as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- 2) Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION 15800

SECTION 15990 TESTING ADJUSTING AND BALANCING

PART 1 – GENERAL

1.1 SCOPE:

A. Extent of Work:

- 1) Extent of testing, adjusting, and balancing work is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to: air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work.
- 2) The work consists of setting speed and volume (flow), adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by contract documents.
- 3) The total work required to complete this section of the specifications is to remain the responsibility of the Contractor.

B. Component types of testing, adjusting, and balancing specified in this section includes fans, ductwork systems (including supply, return and exhaust diffusers and grilles), *lab hoods* and piping systems.

1.2 QUALITY ASSURANCE:

A. TAB Credentials: The firm shall have at least five (5) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project. The individual mechanic assigned to this project TAB shall at least five (5) years of TAB experience.

B. Industry Standards: Comply with American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), National Environmental Balancing Bureau (NEBB) or Associated Air Balance Councils (AABC) recommendations pertaining to measurements, instruments, as well as testing, adjusting, and balancing.

C. The test and balance work shall be performed under the mechanical subcontract by an independent NEBB or AABC member contractor. Final reports shall be prepared by the test and balance subcontractor and submitted to the Owner through the mechanical subcontractor.

1.3 SUBMITTALS: Comply with Sections 01300 and 15000.

A. Submit certified test reports signed by Test and Balance Supervisor who performed TAB work. Include identification and types of instruments used and their most recent calibration data with submission of final test report.

B. Maintenance Data: Include in maintenance manuals, copies of certified test reports.

1.4 JOB CONDITIONS:

A. Do not proceed with testing, adjusting, and balancing work unit Work has been completed and is operable. Ensure that there is no latent residual work still to be completed.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

PART 2 – PRODUCTS

- 2.1 PATCHING MATERIALS: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings. Do not leave test holes uncovered.

PART 3 – EXECUTION

3.1 INSPECTION:

- A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.
- B. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- C. Examine equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- D. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1) Permanent electrical power wiring is complete.
 - 2) Equipment and duct access doors are securely closed.
 - 3) Balance dampers are open.
 - 4) Isolating and balancing valves are open and control valves are operational.
 - 5) Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6) Windows and doors can be closed so design conditions for system operations can be met.
- G. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

- 3.2 TESTING, ADJUSTING, AND BALANCING: Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as follows:
- A. Balance the air system(s) in the following manner:
 - 1) Test and adjust blower speed or vane setting to design requirements within +/- 5 % of design requirements).
 - 2) Test and record motor full load amperes.
 - 3) Make pitot tube traverse of main supply ducts and obtain design cfm at fans.
 - 4) Test and record system static pressures, suction and discharge.
 - 5) Test and adjust system for design cfm recirculated air.
 - 6) Test and adjust system for design cfm outside air.
 - 7) Test and record entering air temperatures of heating and cooling coils (both db and wb of cooling coils).
 - 8) Test and record leaving air temperatures of heating and cooling coils (both db and wb of cooling coils).
 - 9) Adjust all main supply and return air ducts to proper design cfm.
 - 10) Test and adjust each diffuser, grille and register to within +/-10 % of design requirements. Use proportional method of balancing. All outlets shall be reread after final adjustment.
 - 11) Each grille, diffuser, and register shall be identified to location and area on set of drawings.
 - 12) Size, type and manufacturer of diffusers, grilles, registers, and tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
 - 13) Readings and tests of diffusers, grilles and registers shall include required fpm velocity and test resultant velocity, required cfm and test resultant cfm after adjustments.
 - 14) In cooperation with the control manufacturer's representative setting adjustments of automatically operated dampers to operate as specified, indicated and / or noted.
 - B. Prepare reports of test results, including instrumentation calibration reports, in format recommended by applicable standards.
 - C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 - D. Mark equipment settings, including damper control positions, valve indicators, manual fan speed controllers and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

- E. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- F. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15990

SECTION 16010 BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES:

- A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 General Requirements

1.2 DRAWINGS: The Electrical Drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the existing work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. Because of the small scale of the Electrical Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, offsets, and accessories as may be required to meet such conditions.

1.3 REFERENCES:

- A. The latest applicable edition of specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:

- 1) National Electrical Code
- 2) National Fire Protection Association's Recommended Practices
- 3) Local, City & State Codes & Ordinances
- 4) National Electrical Safety Code
- 5) Underwriter's Laboratories, Inc.
- 6) Illumination Engineering Society
- 7) Institute of Electrical & Electronic Engineers
- 8) Insulated Power Cable Engineers Association
- 9) National Electrical Manufacturers Association
- 10) Earthquake Requirement of the International Building Code
- 11) American Society for Testing Materials
- 12) Occupational Safety & Health Act
- 13) Service requirements of serving utility company
- 14) Americans with Disabilities Act (ADA)
- 15) ASHRAE / IESNA Standard 90.1

1.4 SUBMITTALS:

- A. Submit product data grouped to include complete submittals of related systems, products, and accessories in a single submittal using manufacturer's cutsheets. The basic information for each item of equipment to be included is as follows:

- 1) Index of submitted items
- 2) Installation and operation Instructions

- a) Manufacturer descriptive literature
- b) Wiring diagrams if any
- 3) Each submittal sheet shall be clearly marked with equipment Catalog Number and accessory items being submitted highlighted as necessary on sheets with multiple catalog numbers.

1.5 REGULATORY REQUIREMENTS:

- A. Work shall conform to all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor, in such cases, may at his option propose any article, approved equal to or better than that specified, as approved in writing by the Architect.
- C. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- D. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the contract documents, the most stringent shall govern. The contractor shall promptly notify the Architect in writing of any such difference.
- E. Non-Compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.
- F. All required fees, permits and inspections shall be obtained and paid for by the contractor under the section of the specifications for which they are required.

1.6 UTILITY FEES AND REQUIREMENTS:

- A. This Contractor shall be responsible for all costs incurred by the serving utilities for the relocation, removal, and installation of new services.
- B. The Contractor shall be responsible for coordinating and providing the exact service equipment and installation methods with the serving Utility prior to bidding. Failure to do so will not constitute sufficient grounds for an authorized change order to the project.

1.7 PROJECT / SITE CONDITIONS:

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Architect / Owner reserves the right to relocate any device a maximum distance of 6' - 0" at the time of installation without an extra cost being incurred.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect / Engineer before proceeding.

1.8 CONTRACTOR REVISED DRAWINGS:

- A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of

changes may be kept by accurately making all changes on a set of prints during the progress of the job.

- B. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Architect, one set of "contractor revised" reproducibles, legibly and accurately marked to indicate all changes and additions.
- C. This Contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause of extras after the contract is signed, by reason of unforeseen conditions.

1.9 SHOP DRAWINGS:

- 1.10 The Contractor shall submit five (5) copies to the Architect for approval, a list of all equipment he proposes to furnish, together with descriptive literature, capacities, manufacturer's name, approximately delivery date and any other pertinent facts concerning the various items. The submittal shall consist of a tabulation of all items included, followed by catalog and data sheets, wiring diagrams, etc., all bound in one folder, loose leaf sheets will not be acceptable.
- 1.11 The equipment listed herein or on the drawings will be furnished as specified unless scheduled "or equal". If "or equal" is indicated, the product of any reputable manufacturer regularly engaged in the commercial production of the specified equipment will not be excluded on the basis of minor differences, provided all essential requirements of this specification relative to materials, limitations of available space for equipment, capacity, and performance are met. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.
- 1.12 Wherever the substituted equipment actually furnished under these specifications requires the use of larger connections, more connections, or a different connection arrangement than indicated on the drawings or specified under these specifications, the Contractor shall furnish a scaled drawing showing how he proposes to install substituted equipment. Drawings shall show clearances and be coordinated with other mechanical and electrical equipment in the space. Should a substitution require the Architect or Engineer to provide additional services to accommodate it, the Contractor shall be responsible for costs incurred by the Architect or Engineer.
- 1.13 All equipment having motors 1-1/2 horsepower and larger shall include have as part of the submittal package, a written description of the motor, manufacturer, model number and motor efficiency at full load. Failure to include motor data in the equipment submittal shall result in the automatic rejection of the submittal.
- 1.14 The Contractor shall submit shop drawings to the Architect in accordance with the schedule prepared by the General Contractor but not later than 45 calendar days after the date of the agreement. Failure to submit shop drawings within 45 days, shall disqualify the Contractor from substituting specified equipment.
- 1.15 The contractor shall not install any equipment or materials until the shop drawings for the equipment or materials have been approved.
- 1.16 INSTRUCTIONS OF OWNER'S REPRESENTATIVE: The Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical and electrical systems. A competent representative of the Contractor

shall spend sufficient time in such formal instruction to fully prepare the Owner to operate and maintain the Electrical Systems.

1.17 OPERATING AND MAINTENANCE MANUALS:

- A. After approval of materials and equipment for use in this project, a copy of an Operation and Maintenance Manual shall be submitted for approval.
- B. The basic information for each item of equipment to be included is as follows:
- C. Index
- D. Maintenance and operating instructions
- E. Manufacturer's descriptive literature and maintenance manuals
- F. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Architect and hold two (2) copies for instruction of Owner as hereinafter specified.

1.18 GUARANTEE:

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.
- B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Architect, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of one (1) year.
- C. WARRANTY: The Contractor shall, after completion of the original test of the installation, and acceptance by the Architect, provide any service incidental to the proper performance of the plumbing, air conditioning, ventilating, heating and control systems under guarantees outlined above for a period of one (1) full year after acceptance by the Architect and Owner. Regardless of anything to the contrary in warranties by the equipment manufacturer involved, the Contractor's warranty shall run for one (1) full year after final acceptance by the Architect.

1.19 DEFINITIONS:

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

1.20 ELECTRICAL LICENSE REQUIREMENT:

- A. No person shall perform electrical work on the contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS:

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the material. The equipment to be furnished under each section of the specification shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. When two (2) or more units of materials or equipment of the same type or class are required, these units shall be products of one (1) manufacturer. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance. Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- D. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment and materials shall be delivered to the site and stored in the original containers, suitably sheltered from the elements. Items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.
- F. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.
- G. It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.
- H. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. Should the Contractor perform any work that does not comply with the manufacturer's directions, he shall bear all costs arising in correcting the deficiencies.

2.2 EQUIPMENT ACCESSORIES:

- A. The Contractor shall furnish and install all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner, whether or not specifically shown on the plans or herein specified.
- B. Connections: All final connections to equipment shall be installed as required by the manufacturer and / or Vendor.
- C. Connections Different from Those Shown: Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly with the intent of the drawings and specifications. When directed, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes. The Contractor shall provide any

additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing in and connections by other trades. All changes shall be made at no increase in the contract amount or additional cost to the other trades.

PART 3 – EXECUTION

3.1 COORDINATION OF WORK:

- A. The Contractor shall compare the Electrical Drawings and Specifications with the drawings and specifications for other trades including that of the Utility and shall report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the Electrical Work. The Electrical Work shall be installed in cooperation with other trades installing related work. Before installation, the Contractor shall make proper provision to avoid interferences. All changes required in the work of the Contractor caused by a failure to coordinate the work with other trades shall be made by the Contractor at his own expense.
- B. Anchor bolts, sleeves, inserts and supports that may be required for the Electrical Work shall be furnished under the same section of the specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them, which trade shall also insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor under the section of the specifications for the trade with the responsibility for directing their proper location.
- C. Slots, chases, openings and recesses through floors, walls, ceilings and roofs as specified will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located, and shall do any cutting and patching caused by the neglect to do so. Slots, chases, openings and recesses in existing structure shall be cut by the trade requiring them and patched and repaired by that trade.
- D. Locations of conduits and electrical equipment, etc. shall be adjusted to accommodate the work and to avoid interferences anticipated and encountered. The Contractor shall determine the exact route and location of each conduit and equipment gear prior to installation.
 - 1) Right-of-Way: General and structural components have right of way. Equipment and piping whose elevations cannot be changed shall have the right of way over equipment and piping whose elevations can be changed. The Contractor shall coordinate the location of all electrical gear and piping with all trades prior to installation.
 - 2) Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, air vents, sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.

E. Installation and Arrangement: The Contractor shall install all Electrical Equipment to permit removal (without damage to other parts). Provide adequate access to all other parts requiring periodic replacement or maintenance. The Contractor shall arrange equipment to permit ready access to components and to clear the openings of swinging and overhead doors and of access panels.

3.2 REMOVAL OF RUBBISH:

A. Contractor shall remove his rubbish from building site at intervals and shall maintain the spaces allotted him in an orderly manner. On completing his work, and prior to submission of final estimate, he shall remove all tools, appliances, material and rubbish from the grounds.

3.3 ROTATIONAL TESTS:

A. The Contractor shall perform rotational tests on all motors provided under this contract. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.

3.4 CUTTING AND PATCHING:

A. Under each Section of the specifications, the Contractor shall be responsible for all required digging, cutting, etc., incident to his work under that Section, and shall make all satisfactory repairs, but in no case shall the Contractor cut into any major structural element, beam or column.

B. Pavements, sidewalks, roads and curbs shall be cut, patched, repaired and / or replaced as required to permit the installation of the work of the various trades and such cutting, patching, repairing and replacing shall be the responsibility of and paid for by the Contractor under the Section of the specifications for the trade requiring the work.

C. Each trade shall bear the expense of all cutting, patching, repairing or replacing of the work of other trades required because of his fault, error or tardiness or because of any damage done by him.

3.5 EXCAVATION AND TRENCHING FOR ELECTRICAL CONDUIT:

A. Trench Excavation and Backfill: By Utility

B. Depth of Cover: By Utility

C. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

3.6 CONSTRUCTION PHASING:

A. The Contractor shall refer to the General Requirements of this specification and prepare all work schedules required to perform all work as shown on the Drawings and as herein specified.

B. All services shall be maintained to all areas of the building during this Contract. Temporary service connections will be required where necessary to maintain these

- services. The Contractor will make these connections as required to provide continuous service.
- C. It will be the responsibility of the Contractor to carefully review the drawings, specifications and existing conditions with reference to these types of services so that the building may function normally during the construction process.
 - D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
 - E. Galvanized surfaces damaged during installation shall be repaired with a galvanized repair compound complying with Mil Spec DOD-P-21035B. Any equipment scratched, marred or damaged will be repainted to the original condition.

END OF SECTION 16010

SECTION 16055 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical identification specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical identification is indicated by drawings and schedule.
- B. Types of electrical identification specified in this section include the following:
 - 1. Cable conductor identification (not including low voltage)
 - 2. Danger signs
 - 3. Equipment/system identification signs
- C. Refer to electrical general provisions sections for equipment system nameplates and performance data.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with not less than 5 years of successful experience in installation of raceways similar to those required for this product.
- C. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each identification material and device required. Include data substantiating that materials comply with requirements.
- B. Sample: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufactures offering identification products which may be incorporated in the work include, but are not limited to, the following:
1. Almetek Industries, Inc.
 2. Brady Co.
 3. Cole-Flex Corp.
 4. Griffolyn Company
 5. Ideal Industries, Inc.
 6. LEM Products, Inc.
 7. National Band and Tag Co.
 8. Radar Engineers Div.; EPIC Corp.
 9. Seton Name Plate Co.
 10. Tesa Corp.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Engraved Plastic-Laminate Signs:
1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness' indicated, engraved with engraver's standard letter style of sizes and wording indicated, black and white core (letter color) except as otherwise indicated, punched for mechanical fastening.
 - a. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
 - b. Fasteners: Self-tapping stainless steel screws.

2.3 LETTERING AND GRAPHICS

- A. Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or as required for proper identification and operation/maintenance of electrical systems and

equipment. Specific wording shall be approved by the Engineer.

PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Coordination: Where identification is to be applied to surfaces which requires finish, install identification after completion of painting.
2. Regulations: Comply with governing regulations and requirements or authorities having jurisdiction for identification of electrical work.

B. Operational Identification and Warnings:

1. Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

C. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
 - a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110 - 120 volts.
 - b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

D. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide double line of text, 3/8" high lettering on 1 - 1/2" high sign, white lettering in black field for items fed from normal power circuits. Provide text matching terminology and numbering of the

contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

- a. Panel boards, electrical cabinets and enclosures
- b. Electrical switchgear
- c. Motor control centers
- d. Power transfer equipment
- e. Transformers
- f. Starters
- g. Disconnects
- h. Junction boxes larger than 8" x 8"
- i. Circuit breaker enclosures
- j. Power generating units

2. The following are sample:

Panel	Panel XXX	XXX AMPS
xxx/xxx Volts	X Phase	X Wire
Equipment	(Equipment Name)	
Panel XXX	Circuit XX	
Disconnect	(Equipment Name)	
Panel XXX	Circuit XX	

- 3. Signs for equipment on emergency power shall be white with red letters, and signs for equipment on normal power shall be black with white letters.
- 4. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners.
- 5. Signs located at the following items shall have text which will provide manufacturing date and serial number:
 - a. Service entrance equipment
 - b. Transformers (greater than 45 KVA)

- c. Switchgear and switchboards
- d. Standby generators
- e. Transfer switches
- f. Motor control centers

END OF SECTION 16055

SECTION 16070 ELECTRICAL CONNECTIONS FOR EQUIPMENT
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section and is part of each Division 16 section referring to electrical connections specified herein.
- C. See Division 16 Section 16110 for conduit and Division 16 Section 16112 for surface mounted raceway.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include, but not necessarily limited to, connections for providing electrical power to equipment.
- B. Types of electrical power connections specified in this section include the following:
 - 1) Distribution system
 - 2) Branch circuits
 - 3) Grounding
 - 4) Circuit Breakers
 - 5) Panelboards
 - 6) To ground
- C. Junction boxes and other electrical units of equipment are specified in applicable Division 16 sections.
- D. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturing of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical connection work similar to that required for project.

- C. NEC Compliance: Comply with applicable portions of NEC as to type projects used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.
- D. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to electrical connections for equipment.
- E. ANSI Compliance: Comply with applicable ANSI standards pertaining to products and installation of electrical connections.
- F. Labels: Provide electrical connection products and materials, which have been listed or labeled by a nationally recognized testing laboratory engaged in the testing, listing and labeling of electrical materials and equipment.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of product):
 - 1) Appleton Electric Co.
 - 2) Arrow-hart Div., Crouse-Hinds Co.
 - 3) Burndy Corp.
 - 4) Ideal Industries, Inc.
 - 5) T and B/Thomas and Betts Corp.

2.2 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices and termination of types indicated.
- B. Metal Conduit, Tubing and Fittings:
 - 1) General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements; comply with NEC Division 16 basic materials and methods sections “Raceways”, and in accordance with the following listing of metal conduit, tubing and fittings.
 - a) Galvanized Rigid steel conduit

- b) Rigid metal conduit fittings
 - c) Electric metallic tubing
 - d) EMT Fittings
- C. Wire, Cable and Connectors:
- 1) General: Provide wires, cables and connectors complying with Division 16 basic materials and methods section "Wires and Cables".
 - 2) Wire: Unless otherwise indicated, provide wires/conductors for electrical connections, which match wires/conductors of wire supplying power.
- D. Electrical Connection Accessories:
- 1) Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wire nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTION

- A. Install electrical connections as indicated; in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- C. Coordinate installation of all required electrical connections for equipment with equipment supplier.
- D. Cover splices with electrical insulation equivalent to, or of higher rating, than insulation on conductors being spliced.
- E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated.
- F. Trim cables and wires, as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- G. Tighten wire-binding connector screws firmly.

- H. Terminals for Designed Use: Each cable, conductor or wire shall terminate in a lug designed for that particular use: (i.e., one conductor per lug unless lug is designed to have additional conductors installed).
- I. Check and re-tighten all splices, joints, terminations and connections originally installed by the manufacturer, where bolted, threaded or other mechanical means were used to secure joints and splices.

END OF SECTION 16070

SECTION 16110 - RACEWAYS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical raceways specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the following:
 - 1. Electrical metallic tubing
 - 2. Flexible metal conduit
 - 3. Liquid-tight flexible metal conduit
 - 4. Rigid metal conduit
 - 5. Non-metallic conduit

1.3 QUALITY ASSURANCE

- A. Installer: A firm or individual with not less than 5 years of successful experience in installation of raceways similar to those required for this project.
- B. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to raceways.
- C. UL Compliance with Labeling: Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components, which have been UL-listed and labeled.
- D. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of raceway systems.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness') for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill Wiring

requirements, and comply with applicable portions of NEC for raceways.

- B. Rigid Steel Conduit: FS WW-C-0581 and ANSI C80.1
 - 1. Minimum size shall be 3/4 inch
- C. Rigid Metal Conduit Fittings: FS W-F-408
 - 1. Use Type 1 fittings for raintight connections
 - 2. Use Type 2 fittings for concrete tight connections
 - 3. Use Type 3 fittings for other miscellaneous connections
- D. Electrical Metallic Tubing (EMT): FS WW-C-563 and ANSI C80.3
 - 1. Minimum size shall be 3/4 inch
- E. EMT Fittings: FS W-F-408
 - 1. Use Type 1 fittings for raintight connections
 - 2. Use Type 2 fittings for concrete tight connections
 - 3. Use Type 3 fittings for other miscellaneous connections
- F. Flexible Metal Conduit: FS WW-C-566, of the following type:
 - 1. Minimum size shall be 1/2 inch
 - 2. Type 2: Zinc-coated steel
- G. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, and Style A
- H. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible and continuous, interlocked, and double-wrapped steel; galvanize inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).
 - 1. Minimum size shall be 3/4 inch
- I. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G
- J. Non Metallic Conduit: Schedule 80 PVC
 - 1. Minimum size shall be 1 inch
 - 2. NEMA TC 2 Pipe
 - 3. NEMA TC 3 Fittings

4. Manufacturers:
 - a. Carlon
 - b. Engineer Approved

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.
 1. The use of ceiling support wires or tie wires is not acceptable as support or fastening for raceways or conduit.
- B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- C. Level and square raceway runs, and install at proper elevations and/or heights. Conduit shall be run parallel and perpendicular to the building construction.
 1. All conduit shall be installed above other trades (ductwork, piping, etc.) and supported to the structure.
 2. In corridors, the conduit should be installed to one or each side (either high on the wall or at structure) for accessibility.
- D. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- E. Install flexible conduit for motor connections, final connections to light fixtures, and for other electrical equipment connections where subject to movement or vibration.
- F. Install liquid-tight flexible conduit for connection of motors and for other electrical equipment in all central plants, boiler rooms, and where subject to movement and vibration (six foot maximum length), and also where subjected to one or more of the following conditions:
 1. Exterior location
 2. Moist or humid atmosphere where condensate can be expected to accumulate
 3. Corrosive atmosphere
 4. Subjected to water spray
 5. Subjected to dripping oil, grease, or water
 6. Wherever possible, install horizontal raceway runs above water and steam

pipng

- G. All interior concealed conduit shall be EMT with die cast compression fittings. Use flexible metal conduit at final fixture and equipment connections only, not longer than six feet.
 - 1. Use of rigid nonmetallic and flexible nonmetallic conduit in any interior applications is unacceptable.
 - 2. Final connections to lay-in light fixtures shall be made with a 6 foot length of flexible conduit from a junction box to the fixture. Flexible conduit connections from fixture to fixture will not be acceptable.
- H. For interior exposed locations such as Storage, Mechanical, and similar rooms the following shall apply:
 - 1. Lighting and power circuits below 10' - 0" AFF: all conduit shall be galvanized rigid steel (GRSC).
 - 2. Lighting and power circuits above 10' - 0" AFF: conduit is permitted to be electrical metallic tubing (EMT).
 - 3. Communications (telephone, computer, EMCS, and similar) systems conduit is permitted to be EMT.
- I. For interior exposed conduit locations such as Electrical Rooms and Communications Closets the following apply:
 - 1. Lighting and power circuits shall be GRSC or EMT.
 - 2. Communications systems conduit shall be GRSC or EMT.
- J. All concealed or exposed panel feeders and three phase motor branch circuits shall be GRSC.
- K. For exterior exposed conduit locations on Cooling Towers conduit shall be GRSC with minimum 40 mil PVC coating or equivalent. All conduit installed below grade shall be rigid steel or Schedule 80 PVC with rigid steel elbows.
- L. All conduit installed below grade shall be rigid steel or Schedule 80 PVC with rigid steel elbows.
- M. Arrange supports to prevent misalignment during wiring installation.
- N. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Supports shall be installed within 3 feet of every outlet box, junction box, panel, fitting, etc. Do not space supports further than 10 feet apart.
- O. Group related conduits; support using conduit rack. Construct rack using steel channel.

- P. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.
- Q. Arrange conduit to maintain headroom and present neat appearance.
- R. Install insulated bushings on each end of power conduit 1-1/4 inch and larger and on all auxiliary systems conduit.
- S. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 F. Wherever possible, install horizontal raceway runs above water and steam piping.
- T. Cut conduit square using saw or pipecutter; de-burr cut ends.
- U. Bring conduit to shoulder of fittings; fasten securely.
- V. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- W. Install no more than equivalent of three 90-degree bends between boxes. Use factory elbows for all 90 degree bends for conduits 1-1/4" or larger.
- X. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Y. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- Z. Provide suitable pull string in each empty conduit except sleeves and nipples.
- AA. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.
- AB. Ground and bond conduit under provisions of Section 16452.
- AC. Identify conduit under provisions of Section 16055.
- AD. Provide suitable pullboxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.

3.2 COORDINATION WITH OTHER TRADES

- A. All conduit shall be installed as high as possible being supported directly to bottom of structure to avoid conflicts with ductwork and piping. In corridors, conduit shall be mounted to the sides of the corridor either on the wall up high or to the structure. The electrical contractor shall coordinate installation with the mechanical contractor.

3.3 ADJUSTING AND CLEANING

- A. During installation of raceways, inspect interiors of raceways; remove burrs, dirt, and construction debris.

- B. Upon completion of installation of raceways and before conductor installation, inspect interior of raceways and swab out dirt and construction debris.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve all partition ratings to include, but not be limited to, fire, sound, and HVAC (plenum).
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- C. Pullboxes shall be provided at points shown on the plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction.
- D. All threaded conduit shall be secured to boxes, cabinets, panels, etc. by means of a threaded bushing on the inside and locknuted on the box exterior and interior.

3.5 PROHIBITED USES

- A. EMT set-screw fittings.
- B. Spray (aerosol) PVC cement.
- C. All thread nipples in other than dry locations.
- D. Wooden plugs inserted in concrete or masonry units as bases for fastening conduits, tubing, boxes, cabinets, or other equipment.
- E. Installation of conduit or tubing, which has been crushed or deformed.
- F. Torches for bending PVC conduit.
- G. LB Fittings. All bends for conduits 1-1/4" or larger shall be factory made 90 degree elbows.
- H. Wire nuts shall not be used for splicing control wiring.

END OF SECTION 16110

SECTION 16120 - WIRES AND CABLES

PART 1 GENERAL

1.1 GENERAL

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 15 and Division 16 section making reference to wires and cables specified herein.

1.2 RELATED SECTIONS

- A. Section 15900
- B. Section 16055
- C. Section 16010

1.3 REFERENCES

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; Latest Edition.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; Latest Edition.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Latest Edition.

1.4 DESCRIPTION OF WORK

- A. Extent of electrical wire and electrical cable work is indicated by drawings and schedules.
- B. Types of wire, cable and connectors in this section include the following:
 - 1. Copper conductors (low voltage power and control)
 - 2. Fixture wires
 - 3. Pigtail type connectors
 - 4. Tap type connectors
 - 5. Split-bolt connectors

- C. Applications for wire, cable and connectors in the section required for project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting circuitry
 - 3. Appliance and equipment circuitry
 - 4. Motor-branch circuitry
 - 5. Fire alarm circuitry
 - 6. HVAC controls
 - 7. Facility management systems

1.5 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical wire and cable products of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical wiring work similar to that required for project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wire, cable and connectors.
- D. UL Compliance: Comply with UL standards pertaining to wire, cable and connectors.
- E. UL Labels: Provide electrical wires, cables and connectors which have been UL-listed and labeled.
- F. NEMA/ICEA Compliance: Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of wire and cable.
- G. ANSI/ASTM: Comply with applicable portions of ANSI/ASTM standards pertaining to construction of wire and cable.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's data on wires and cables including dimensions, capacities, ratings, performance characteristics, gages and installation instructions.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable and connector):
1. Wire and Cable:
 - a. Advance Wire and Cable, Inc.
 - b. Cerro Wire and Cable Co.
 - c. Electrical Conductors, Inc.
 - d. General Cable Corp.
 - e. Hitemp Wires, Inc.
 - f. Rome Cable Corp.
 - g. Southwire Company
 - h. Triangle PWC, Inc.
 2. Connectors:
 - a. AMP, Inc.
 - b. Burndy Corp.
 - c. Gould, Inc.
 - d. Ideal Industries, Inc.
 - e. O-Z/Gedney Co.
 - f. Pyle National Co.
 - g. Thomas and Betts Co.

2.2 WIRE, CABLE AND CONNECTORS

- A. General: Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation.
- B. 600 Volt Wire:
1. Provide factor-fabricated wire of sizes, ratings, materials and types indicated for each service. Where not indicated, provide proper selection as determined by Owner to comply with project's installation requirements and NEC standards. Select from the following types, materials, conductor configurations, insulation and coverings:

UL Type: THHN

UL Type: THW

UL Type: THWN

UL Type: XHHW

Material: Copper

Conductors: Solid (AWG 12 and AWG 10 only)

Conductors: Concentric-lay-standard (standard flexibility)

Outer Covering: Cross-link polyethylene

Outer Covering: Thermoplastic

2. 600 volt conductors to be color coded as follows:

120/208 Volt Conductors:

Phase A - Black

Phase B - Red

Phase C - Blue

Neutral - White

Isolated Ground - Green with Orange Stripe

Equipment Ground - Green

277/480 Volt Conductors:

Phase A - Brown

Phase B - Orange

Phase C - Yellow

Neutral - Gray

Equipment Ground - Green

C. Cable:

1. Provide factory-fabricated cable of sizes, ratings, materials, and jacketing/sheathing as indicated for each type service. Where not indicated, provide proper selection as determined by Engineer to comply with installation requirements and NEC standards.

D. DDC System Multi-Conductor Instrumentation And Communication Cabling:

1. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC and General Purpose Cabling:
 - a. Cable shall consist of copper conductors not less No. 18 AWG stranded.
 - b. Shall be 2 or 3 conductor twisted cable with a drain wire.
 - c. Cable shall have a 100% overall shield.
 - d. Cable shall be plenum rated.
 - e. Cable shall meet or exceed NEC voltage rating of 300V.
 - f. Cable shall be NEC type CMP.
 - g. Cable shall meet or exceed UL temperature rating of plus 60 C.
2. Primary and Secondary Communications Network Cabling:
 - a. Cable shall be of type recommended by the DDC System Manufacturer.
 - b. Cable shall be shielded.
 - c. Cable shall be plenum rated.
 - d. Cable shall meet or exceed NEC voltage rating of 150V.
 - e. Cable shall meet or exceed UL temperature rating of plus 60 C.
 - f. Cable identified on installation drawings as "N2" shall be labeled at a minimum of every 18" with the DDC system manufacturer's name, system name, and the communications network name.
 - g. Each of the cable types shall be of a different color coding for easy identification and trouble shooting. Cable identified on installations drawings as "N2" shall be blue in color.
3. Room Sensor Cabling:
 - a. Cable shall consist of copper conductors not less No. 24 AWG.
 - b. Shall be multi-paired (at least two pairs) twisted cable.
 - c. Cable shall have a 100% overall shield.
 - d. Cable shall be plenum rated.
 - e. Cable shall meet or exceed NEC voltage rating of 300V.

- f. Cable shall be NEC type Article 800-CMP.
 - g. Cable shall meet or exceed UL temperature rating of plus 75 C.
- E. Connectors:
- 1. General: Provide factory-fabricated, metal connectors of sizes, ratings, materials, types and classes as indicated for each service. Where not indicated, provide proper selection as determined by Engineer to comply with installation requirements and NEC standards. Select from the following types, classes, kinds and styles.
 - Type: Pressure
 - Type: Crimp
 - Type: Threaded
 - Class: Insulated
 - Class: Non-insulated
 - Kind: Copper
 - Style: Butt connection
 - Style: Elbow connection
 - Style: Combined "T" and straight connection
 - Style: Insulation-piercing tap connection
 - Style: Split-bolt parallel connection
 - Style: Tap connection
 - Style: Pigtail connection

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to installation verify that interior of building has been protected from weather.
- B. Prior to installation verify that mechanical work likely to damage wire (and cable) has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. Interior Locations: Use only building wire, Type THW or THHN/THWN insulation, in raceway unless otherwise indicated on the Drawings.
- B. Wet or Damp Interior Locations: Use only building wire, Type THW or THHN/THWN in raceway or liquid tight flexible conduit.
- C. Exterior Locations: Use only building wire, Type THW or THHN/THWN insulation in raceway.
- D. Underground Installations: Use only building wire, Type THW or THHN/THWN insulation in raceway.
- E. Use wiring methods indicated on Drawings.

3.4 INSTALLATION:

- A. Install products in accordance with manufacturer's instructions.
- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits 24 volts and below. Minimum size shall be 16 AWG or as indicated on the contract drawings or approved vendor shop drawings.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits (including all fixture whips) and 120 volt control circuits.
- E. Conductors shall be continuous from outlet to outlet.
- F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet or where the distance to the first outlet exceeds 50 feet.
- G. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Protect exposed cable from damage.
- K. Support cables above accessible ceiling, unistrut, bridle rings, and cable ties to support cables. Do not rest cable on ceiling panels.
- L. Use suitable cable fittings and connectors.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

- P. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape as follows:
 - 1. Make a smooth assembly with 3-M Scotchfil insulating putty. Putty to fill all voids and be tapered to wire insulation to form a smooth transition.
 - 2. Finish with two 1/2 lapped layers of Scotch 33 plus plastic tape.
- Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- S. Route circuits at own discretion; however, circuit numbers shall be according to Drawings.
- T. On 3 phases, 4 wire systems, do not use a common neutral for more than 3 circuits. More than 3 circuit in any 1 conduit is not allowed without written permission from the Engineer.
- U. On single phase, 3 wire systems, do not use a common neutral for more than 2 circuits. More than 2 circuits in any 1 conduit is not allowed with written permission from the Engineer.
- V. Where a common neutral is run for 2 or 3 homerun circuits, connect phase conductors to breakers in panel which are attached to separate phase legs in order that the neutral conductors will carry only the unbalanced current. Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
- W. Run conductors of same circuit in same conduit.
- X. Run conductors of different voltage system in separate conduits.
- Y. All wire installed on the load side of branch GFI circuit breakers and isolation power panels shall be type "XHHW" or "XLP". Use of pulling compound on these conductors is prohibited.
- Z. Completely and thoroughly swab raceway before installing wire.
- AA. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- AB. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices

within 10 feet.

3.5 HVAC CONTROL SYSTEM WIRING

- A. All system input wiring shall be twisted shielded pair, minimum 18 gauge wire. All system analog output wiring shall be twisted shielded pair/3 wire as required, minimum 18 gauge wire. Preconfigured cables between terminal unit controllers and thermostats are acceptable, minimum 24 gauge.
- B. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.
- C. All Class 2 (24 VAC or less) wiring shall be installed in conduit unless concealed in accessible locations.
 - 1. Class 2 wiring, when not installed in conduit, shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Exposed wiring shall be installed parallel to the building structural lines. All exposed wiring shall be installed in accordance with NEC and local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.
- D. Low voltage control wiring and 24 VAC may be run in the same conduit. If the insulation ratings are equal (600V), power wiring 120 VAC and greater must be in a separate conduit.
- E. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size is 3/4".

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16055.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings in each junction box, control box, and in each panelboard.

3.7 FIELD QUALITY CONTROL

- A. Perform field inspection and testing.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

3.8 PROHIBITED USES

- A. Types AC and MC cables.
- B. Types NM, NMC, and NMS cables.

END OF SECTION 16120

SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of electrical box and electrical fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
 - 1. Outlet boxes
 - 2. Junction boxes
 - 3. Pull boxes
 - 4. Floor boxes
 - 5. Conduit bodies
 - 6. Bushings
 - 7. Locknuts
 - 8. Knockout closures

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of electrical boxes and fittings, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- D. Compliance: Provide electrical boxes and fittings which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test

electrical equipment.

- E. ANSI/NEMA Standards Compliance: Comply with ANSI C 134.1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports.

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 PRODUCTS

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized flat rolled sheet steel interior outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices. Gangable boxes are not acceptable.
 - 1. Interior Outlet Box Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.
 - a. Outlet Box Mounting Supports: Caddy™ Quick Mount Box Supports H-3 or approved straps or bars.
 - b. Outlet Box Extension Rings: Raco 700 series, square cut.
 - 2. Manufacturer: Subject to compliance with requirements, provide interior outlet boxes of one of the following:
 - a. Adalet-PLM Div, Scott and Fetzer Co.
 - b. Appleton Electric Co.
 - c. Bell Electric/Square D Co.
 - d. Eagle Electric Mfg. Co., Inc.
 - e. Pass and Seymour, Inc.
 - f. RACO, Inc.
 - g. Steel City/Midland-Ross Corp.
- B. Weatherproof Outlet Boxes: Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit. Hubs cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, including face plate gaskets and

corrosion-resistant fasteners.

1. Manufacturers: Subject to compliance with requirements, provide weatherproof outlet boxes of one of the following:
 - a. American Metal Forming Co.
 - b. Arrow-Hart Div., Crouse-Hinds Co.
 - c. Bell Electric/Square D. Co.
 - d. Gould, Inc.
 - e. Harvey Hubbell, Inc.
 - f. O-Z/Gedney Co.
 - g. Pyle-National Co.

- C. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seam and equipped with nuts, bolts, screws, and washers.
 1. Manufacturer: Subject to compliance with requirements, provide junction and pull boxes of one of the following:
 - a. Adalet-PLM Div., Scott and Fetzer Co.
 - b. Appleton Electric Co.
 - c. Arrow-Hart Div., Crouse-Hinds Co.
 - d. Bell Electric/Square D Co.
 - e. GTE Corporation
 - f. Keystone Columbia, Inc.
 - g. O-Z/Gedney Co.
 - h. Spring City Elect Mfg. Co.

- D. Floor Boxes: Provide cast-iron waterproof adjustable floor boxes as indicated in concrete slabs on grade, with thread-conduit-entrance hubs, and vertical adjusting rings, gaskets, brass floor plates and flush duplex flap covers. Stamped steel floor boxes may be used on all floors above grade. Brass floor plate shall be compatible with type of floor finish.
 1. Floor Box Accessories: Provide devices and accessories as indicated on the issued contract drawings.

2. Manufacturer: Subject to compliance with requirements, provide floor boxes of one of the following:
 - a. American Metal Forming Corp.
 - b. Bell Electric/Square D Co.
 - c. Crouse-Hinds Co.
 - d. Harvey-Hubbell, Inc.
 - e. Pyle-National Co.
 - f. Spring City Electrical Mfg. Co.
 - g. Steel City/Midland-Ross Corp.
 - h. Walker Mfg. Co.

- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of types, shapes and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws. Conduit bodies shall be compatible with conduit materials.
 1. Manufacturer: Subject to compliance with requirements, provide conduit bodies of one of the following:
 - a. Allen-Stevens Conduit Fittings Corp.
 - b. Appleton Electric Co.
 - c. Atlas Technologies, Inc.
 - d. Crouse-Hinds Co.
 - e. Gould, Inc.
 - f. Killark Electric Mfr. Co.
 - g. O-Z/Gedney Co.
 - h. Pyle-National Co.
 - i. Spring City Electrical Mfg. Co.

- F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and connectors of one of the following:
 1. Allen-Stephens Conduit Fittings Corp.
 2. Appleton Electric Co.

3. Atlas Technologies, Inc.
4. Burndy Corp.
5. Crouse-Hinds Co.
6. Gould, Inc.
7. O-Z/Gedney Co.
8. RACO, Inc.
9. Steel City/Midland-Ross Corp.
10. Thomas and Betts Co., Inc.

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings where indicated or required, complying with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- C. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture. Weatherproof covers shall be manufactured and installed so that the device is weatherproof during use (equal to RACO).
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install boxes and conduit bodies in those locations to ensure ready accessibility of electrical wiring.
 1. Provide each outlet box with the appropriate extension ring to suit wall thickness.
 2. Install boxes in a manner that preserves the Fire Resistance Ratings or shielding of partitions and other elements.
- F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.
- G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
 1. Securely mount each outlet box to metal studs with Outlet Box Mounting

Supports. If a bar or strap is used, secure to at least two metal studs.

2. The use of ceiling support wires or tie wires is not acceptable as support or mounting for electrical boxes. All electrical boxes shall be independently supported to structure.
- H. Provide equipment grounding connections for all installed boxes. This connection shall be made to the back of the box with an approved green grounding screw. All grounding connections shall be made via pig tails.
- I. No more than 4 gangs (4 openings for a single yoke) shall be permitted. Where additional requirements dictate more than four, another box with appropriate gangs shall be installed.
- J. Insulated throats or plastic bushings shall be installed at all conduit terminations.
- K. Secure fittings to the raceways by tightening set screws to the manufacturer's recommended torque.
- L. Boxes shall not be installed back to back in the same wall. If unavoidable, then the boxes shall have void between boxes completely filled with sound attenuation mineral fiber blanket. No through-the-wall boxes or nipples between boxes are to be used. If back to back boxes are connected, make the connection with flexible metal conduit. There shall be no rigid connections.
- M. All junction and outlet boxes used shall have the circuits contained within clearly marked on the cover.
- N. All fire alarm junction boxes shall be painted red. All fire alarm junction boxes over 4 inches square shall be equipped with terminal strips (labeled) for splice connections.
- O. All communications junction boxes shall be clearly labeled with system enclosed (e.g. "Intercom").

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- B. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes with Architect and vendor drawings prior to rough-in.
- C. Position outlet boxes to locate luminaires as shown on reflected architectural ceiling plan.

3.3 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closure in all unused box openings.

END OF SECTION 16135

SECTION 16140 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electrical energy.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles
 - 2. Switches
 - 3. Wall plates
 - 4. Dimmer controls
 - 5. Attachment plug
 - 6. Plug connectors
 - 7. Floor and counter-top service outlets

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in Manufacturer of wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring devices.
- D. Compliance and Labeling: Provide electrical wiring devices which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test electrical equipment and materials.

- E. NEMA Compliance: Comply with NEMA standards for general and specific-purpose wiring devices.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):
 1. Arrow-Hart
 2. Hampden
 3. Harvey Hubbell Inc.
 4. Leviton
 5. Lightolier
 6. Lutron
 7. Square D Co.
 8. Walker/Parkersburg Div., Textron Inc.

2.2 FABRICATED WIRING DEVICES

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and complying with NEMA Stds. Pub. No. WD 1. Where types and grades are not indicated, provide proper selection as determined by Architect/Engineer to fulfill wiring requirements, and complying with NEC and NEMA standards for wiring devices. Provide ivory color devices for all devices. All devices shall have side wired screw terminals.
- B. Receptacles:
 1. Commercial Specification Grade Duplex: Provide duplex commercial specification grade type receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears, nylon face, NEMA configuration 5-20R unless otherwise indicated. Hubbell 5362I/Arrow-Hart 5362I/Leviton 5362I.
 2. Ground-Fault Interrupter: Provide commercial specification grade, duplex receptacle, 2-pole, 3-wire, grounding type UL-rated Class A, Group 1, 20-amperes rating, 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; equip with 20 ampere

plug configuration, NEMA 5-20R. Hubbell GF 5362I/Leviton 5262I.

3. Commercial Specification Grade Duplex Isolated Ground: Provide duplex commercial specification grade type receptacles, 2-pole, 3-wire grounding, isolated ground connection with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears, nylon face, orange color, NEMA configuration 5-20R unless otherwise indicated. Provide Hubbell IG5362, Arrow-Hart #IG5362, or Leviton 5362-IG.
4. Surge Suppression Duplex: Provide commercial specification grade type receptacle UL Listed 1449 and 498, 2-pole, 3 wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 amperes, 125 volt with metal plaster ears, NEMA configuration 5-20R, nylon face, ivory color, constructed with four 18 mm MOV devices providing 210 joules protection per mode. Protection modes are Line-Neutral, Line-Ground, and Neutral Ground. Surge protection modules shall be constructed of glass PC board and have a conformal coating. Provide unit with a damage alert alarm with "muting", screw and a power-on/functional light. Provide Hubbell #5362IS or Arrow-Hart #5362SI. For isolated ground applications, provide (orange color) Hubbell #IG53620S, Arrow-Hart #IG5362S, or Leviton 5380-IG.

C. Plugs and Connectors:

1. Plugs: Provide grounding, armored cap plugs with cord clamp, and 0.4" cord hole; match NEMA configuration ampacity, voltage and wire quantity with power sources.

D. Switches:

1. Single Pole: Provide commercial specification grade flush single-pole quiet toggle switches, 20-ampere, 277-volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handle. Hubbell HBL 1221I/Arrow-Hart 1221I/Leviton 1221-2.
2. 3-way Snap: Provide commercial specification grade flush 3-way quiet switch, 20-amperes, 277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handles. Hubbell HBL 1223I/Arrow-Hart 1223I/Leviton 1223-2.
3. Four-Way: Provide commercial grade flush four-way quiet toggle switches, 20-amperes, 277-volt AC, with mounting yoke insulated from mechanism, equip with plaster ears, and switch handle. Hubbell HBL 1224I/Arrow-Hart 1224I/Leviton 1224-2.

E. Dimmers:

1. Incandescent Single Pole Dimmers: Provide branch lighting solid-state AC dimmer controls for incandescent fixtures; wattage as indicated, 2000-watt minimum, 120-volts, 60 hertz, with continuously linear slide dimmer, ivory

nylon face plate, single-pole, soft-touch ON-OFF switch. Equip with electromagnetic filters to eliminate noise and interference, and with five inch length wire connecting leads. Lutron Nova N-2000, Lutron NLV-1500 (low voltage application), or approved equal.

2.3 WIRING DEVICE ACCESSORIES

- A. Wall Plates: Provide switch and duplex outlet wall plates for wiring devices, of types, sizes, and with ganging and cutouts as indicated. Where more than one device occurs, provide single piece-plates with appropriate cutout. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; all plates shall be thermo-plastic.
- B. Floor and Countertop Service Outlets: Provide service receptacle outlets and fittings of types and ratings indicated on the Drawings. All floor boxes installed in slab on grade shall be cast iron and floor boxes installed in slab above grade shall be stamped steel as manufactured by Walker.

PART 3 EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. Tighten connectors terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torque's specified in UL standard 486A. Use properly scaled torque indicating hand tool.
- E. Delay installation of wiring devices until wiring work is completed.
- F. Delay installation of wall plates until after wall finish completed. This Contractor shall remove and re-install plates for painting contractor.
- G. Mounting Heights:
 - Receptacles 18" above finish floor unless otherwise noted
 - Switches 48" above finish floor unless otherwise noted
- H. All outlets shown to be mounted above counter shall be mounted accessible. Exact location above counter and mounting configuration shall be coordinated with

Architect and Architectural millwork details.

- I. Install switches with off position down, receptacles with ground pin down and install all devices plumb and square.
- J. Connect wiring devices by wrapping conductor around side mounted screw terminal. Back-wired connections will not be acceptable.
- K. Use jumbo size plates for devices in masonry walls.
- L. All receptacles installed within 6' of any sink, hose bibb or other water source shall be of the GFI type as specified above. Any receptacle installed on the exterior of the building or outdoors shall be the GFI type.
- M. Use of feed-thru GFI protection is not allowed.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

- A. Upon installation of wall plates and receptacles, advise contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING

- A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated. Device grounding connection shall be made via a pig tail from the ground screw within the device backbox. Install in strict accordance with NEC Article 300-13 (b).

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16135 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor except surface mounted devices shall be mounted on top on baseboard.
- D. Install convenience receptacle 6 inches above counter unless noted otherwise.
- E. Install telephone and computer outlets 18 inches above finished floor except surface mounted devices shall be mounted on top of baseboard.
- F. Install fire alarm audio/visual and visual devices 6' - 8" above finish floor.
- G. Install fire alarm pull station 4' - 0" above finish floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 16140

SECTION 16155 - MOTOR STARTERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to motor starters specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Types of motor starter work are indicated by drawings and schedules and include (but are not limited to) the following:
 - 1. Manual with overload protection
 - 2. Full voltage, non-reversing starters
 - 3. Full voltage, non-reversing combination starters/disconnect switches
 - 4. Solid state electronic (Reduced Voltage)

1.3 QUALITY ASSURANCE

- A. Manufacturer: Firms regularly engaged in manufacturer of motor starters, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project.
- C. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motor starters.
- D. UL Compliance and Labeling: Comply with applicable requirements of UL 508, "Electric Control Equipment", pertaining to electrical motor starters. Provide units which have been UL-listed and labeled.
- E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to motor controllers/starters and enclosures.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on motor starters.
- B. Shop Drawings: Submit dimensioned drawings on motor starters showing accurately scaled equipment layouts and spatial relationship to associated motors, and connections to electrical power feeders and panels. All accessory components shall be clearly outlined and identified.
- C. Maintenance Data: Submit maintenance instructions for motor and drive replacements and spare parts listed. Include this data in maintenance manuals.
- D. Maintenance Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 5 units of each. Fuses shall be of a type available from a least 2 manufacturers.

- E. Maintenance Stock, Heaters: For types and ratings required, furnish additional heaters, amounting to 1 unit for each 9 installed, but not less than 3 units of each.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):
 1. Cutler Hammer
 2. General Electric Co.
 3. Square D Co.

2.2 MOTOR STARTERS

- A. General: except as otherwise indicated, provide motor starters and auxiliary components; of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations. Where more than one type of equipment meets indicated requirements, selection is Engineer's option. Provide phase loss and low voltage protection relay in the control circuits of all motors 7-1/2 HP and larger. Size 0 Starters shall be supplied as a minimum. Size 0 starters shall be provided in an oversized enclosure for control wiring. Provide fixed (6-10 seconds) time delay electronic relay in the control circuits of all motor 15 HP and larger connected to an emergency distribution system. Combination units shall be provided with integral non-fused disconnect or circuit breaker as indicated on the Drawings. Starters installed in existing motor control centers shall match existing equipment type, rating, etc.
- B. AC Fractional HP Manual Starters: Provide manual single-phase fractional HP motor starters of types, ratings and electrical characteristics indicated; equip with thermal overload relay for protection of 120 V AC motors of 1/2 HP and less. Provide starters with quick-make, quick-break trip free toggle mechanisms; mount starter in NEMA Type I general purpose enclosure.
- C. AC Full Voltages: Provide full voltage alternating current magnetic starters, consisting of contactors and overload relays mounted in common enclosures; of type, size, ratings and NEMA sizes indicated. Overload relays to be block type with manual reset. Control voltage to be supplied via 120 volt control transformer with fused primary and fused secondary and with a minimum of 2 sets of auxiliary contacts, (two-NO and two-NC) or as required for controls specified. Provide other control components as listed below and as directed by applicable Sections in Division 16.
 1. Green power off pilot light
 2. Red power on pilot light
 3. H-O-A selector switch
- D. Solid State Reduced Voltage: Provide full voltage alternating current solid state starters, consisting of SCR control components, microprocessor based technology, integral thermal sensors mounted in common enclosures; of type, size, ratings and NEMA sizes indicated. The starter shall be keyboard

programmable and have an alphanumeric display. The starter shall have electronic overload in both running and starting conditions. The overload function shall be selectable for either standard or heavy duty motor operation. Provide other features as listed below:

1. Output relays (2 N.O. and 2 N.C. auxiliary contacts)
2. Selection of acceleration modes
3. Adjustable voltage ramp
4. Kickstart feature for high static friction loads
5. Adjustable current limiting
6. Programmable starting torque
7. Energy saving feature for motors under light loads
8. Deceleration by injection of DC voltage "braking"
9. Adjustable deceleration ramp
10. Loss of load detection
11. SCR short circuit protection
12. Loss of input or output phase protection
13. 120 volt control transformer with fused primary and secondary
14. Green "power off" light/red "power on" light
15. H-O-A selector switch

PART 3 EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

- A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install fuses in fusible disconnects, if any.
- C. Install heaters, sized to provide protection in accordance with the manufacturer's recommendations and the NEC in overload relays.
- D. Coordinate auxiliary control requirements with mechanical contractor and application Section of Division 15.
- E. Provide identification as required by Section 16055.
- F. All 3 phase motors, 7-1/2 HP and larger, shall utilize electronic type starters.

3.2 ADJUST AND CLEAN

- A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

- A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 16155

SECTION 16160 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is a part of each Division 16 section making reference to panelboards specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include the following:
 - 1. Power-Distribution panelboards
 - 2. Lighting and appliance panelboards
 - 3. Load Centers
- C. Refer to other Division 16 sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for project.
- C. Special Use-Markings: Provide panelboards, constructed for special use, with UL marks indicating that special type usage.
- D. UL Compliance: Comply with applicable UL safety standards pertaining to panelboards and accessories, and enclosures; provide units which have been UL-listed and labeled.
- E. NEC Compliance: Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC articles pertaining to installation of wiring and equipment in hazardous locations.
- F. NEMA Compliance: Comply with NEMA Std. Pub. No. 250, "Enclosures for Electrical Equipment (1000 volt maximum)", Pub. No. 1 "Panelboards", and installation portion of Pub. No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".
- G. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of panelboard required.

Include data substantiation that units comply with requirements.

- B. Shop Drawings: Submit dimensioned custom drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not necessarily limited to, circuit breakers, fusible switches, fuses ground-fault circuit interrupters, and accessories. Manufacturer's standard catalog sheets are not acceptable.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data in maintenance manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of panelboard and enclosure):
 - 1. Square D Company
 - 2. General Electric Company
 - 3. Cutler-Hammer

2.2 PANELBOARDS

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with number of unit panelboard devices as required for complete installation. Where more than one type of component meets indicated requirements, selection is Installer's option. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.
- B. Power Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for copper conductors. Sub-feed breakers are not allowed unless otherwise noted on the Drawings. Construct unit for connecting feeder at top of panel. Equip with copper bus bars, and full-sized neutral bus; provide suitable lugs on neutral bus for out-going feeders requiring neutral connections. Provide molded-case main circuit breaker or main lugs only (as shown on the drawings) and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with internal common trip so overload on one pole will trip all poles simultaneously. Provide a bare un-insulated grounding bar bolted to enclosures. Provide panelboards fabricated by the same manufacturer as enclosures, and which mate properly with enclosures. Where specified provide isolated ground bus bar.
- C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangement shown; with anti-burn solderless pressure type lug connectors approved for copper conductor; construct unit for connecting feeders at top or bottom of panel as required; equip with copper bus bars, full-sized neutral bar, with bolt-in molded case circuit breakers; provide

suitable lugs on neutral bus for each outgoing feeder required; provide bare un-insulated grounding bar bolted to enclosure; and provide panelboards fabricated by same manufacturer as enclosures; and which mate properly with enclosures. Where specified provide isolated ground bus bar. The branch circuit breaker sub-assembly shall be in continuous contact and bolted to the panel enclosure back-box; sub-assemblies mounted on "Z" brackets are not allowed. The circuit breaker sub-assembly shall utilize thermo-plastic mounting straps to properly align breakers.

- D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Design enclosure for surface or recessed mounting as indicated on the drawings. Provide enclosures fabricated by same manufacturer as panelboards, and which match properly with panelboards to be enclosed.
- E. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to circuit breakers, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.
- F. Load Centers: Provide dead-front safety type load centers as indicated with overcurrent protective devices in quantities, ratings, types and arrangement shown with anti-burn solderless pressure type lug connectors approved for copper conductors, construct for reversible top or bottom feed. Equip with copper plated bus bars, full size neutral and plug-on circuit breakers. Provide suitable lugs on neutral bus for each outgoing branch required. Provide bare un-insulated grounding bar bolted to enclosure. Provide load centers fabricated by same manufacturers as enclosure.

PART 3 EXECUTION

3.1 INSTALLATION OF PANELBOARDS

- A. General: Install panelboards and enclosures where indicated, in accordance with manufacturer's written instructions applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
- D. Provide electrical connections within enclosures.
- E. Fill out (typewritten) panelboard's circuit directory card upon completion of installation work.
- F. Provide identification as required by Section 16055 and as required by the National Electrical Code, 2005 Edition.

- G. Provide a minimum of 6 spare circuit breakers (or more if indicated on the Drawings) in each panelboard and install a minimum of 6 spare 3/4" conduits from each flush mounted panelboard/load center to above an accessible ceiling.
- H. External handle tie type circuits breakers are not acceptable.

END OF SECTION 16160

SECTION 16190 - SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to supports, anchors, sleeves, and seals specified herein.

1.2 DESCRIPTION OF WORK

- A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division 16 sections.
- B. Types of supports, anchors, sleeves and seals specified in this section include the following:
 - 1. C-clamps
 - 2. I-beam clamps
 - 3. One-hole conduit straps
 - 4. Two-hole conduit straps
 - 5. Round steel rods
 - 6. Lead expansion anchors
 - 7. Toggle bolts
 - 8. Wall and floor seals
 - 9. Conduit and box fasteners
- C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 16 sections.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in Manufacturer of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on

projects with electrical installation work similar to that required for this project.

- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical supporting devices.
- D. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA Std. Pub. No. FB1, "Fittings and Supports for Conduit and Cable Assemblies".
- E. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
- F. UL Compliance: Provide electrical components which are UL-listed and labeled.
- G. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining strap for conduit, pipe and cable.

1.4 SUBMITTALS

- A. Product Data: Submit catalog cuts, specifications, installation instructions, for each type of support, anchor, sleeve and seal. Submit hanger and support schedule showing manufacturer's figure number, size, location, and features for each required hanger and support.

PART 2 PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

- A. General: Provide supporting devices complying with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for a complete installation, and as herein specified. Where more than one type of device meets the following requirements, selection is Installer's option.
- B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
 - 1. C-Clamps: Black malleable iron; 1/2" rod size; approx. 70 pounds per 100 units.
 - 2. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.
 - 3. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approx. 7 pounds per 100 units.
 - 4. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
 - 5. Hexagon Nuts: For 1/2" rod size; galvanized steel; approx. 4 pounds per

- 100 units.
6. Round Steel Rod: Black steel; 1/2" dia.; approx. 67 pounds per 100 feet.
 7. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approx. 200 pounds per 100 units.
 8. Conduit and Box Fasteners: Fasteners specifically manufactured for the support of conduit and electrical boxes, UL labeled.
- C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:
1. Lead Expansion Anchors: 1/2"; approx. 38 pounds per 100 units.
 2. Toggle Bolts: Springhead; 3/16" x 4"; approx. 5 pounds per 100 units.
 3. Manufacturer: Subject to compliance with requirements, provide anchors of the following:
 - a. Abbeon Cal Inc.
 - b. Ackerman Johnson Fastening Systems, Inc.
 - c. Elcen Metal Products Co.
 - d. Ideal Industries, Inc.
 - e. Josyln Mfg. and Supply Co.
 - f. McGraw Edison Co.
 - g. Rawlplug Co., Inc.
 - h. Star Expansion Co.
 - i. U.S. Expansion Bolt Co.
 - j. Caddy-Erico Product, Inc.
 - k. Hitt-Thomas Industries, Inc.
- D. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated; and having the following construction features:
1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- E. Conduit Cable Supports: Provide cable supports with insulating wedging plug for

non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable iron casting with hot dip galvanized finish.

F. U-Channel Strut Systems:

1. Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:
 - a. Fixture hangers
 - b. Channel hangers
 - c. End caps
 - d. Beam clamps
 - e. Wiring stud
 - f. Thinwall conduit clamps
 - g. Rigid conduit clamps
 - h. Conduit hangers
 - i. U-bolts
2. Manufacturer: Subject to compliance with requirements, provide channel systems of one of the following:
 - a. B-Line Systems, Inc.
 - b. Elcen Metal Products Co.
 - c. Greenfield Mfg. Co., Inc.
 - d. Midland-Ross Corp.
 - e. Power-Strut Div; Van Huffel Tube Corp.
 - f. Unistrut Div; GTE Products Corp.

2.2 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls

below grade or in exterior walls. All sleeves shall be made watertight.

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

- A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.
 - 1. The use of support wires or tie wires is not acceptable as support for boxes conduit, or equipment.
 - 2. Boxes in ceiling spaces shall be rigidly supported from a structural member of the building directly or by using a metal brace. The metal brace shall be a minimum of 1/4" all thread rod.
- B. Coordinate with other electrical work, including raceway and wiring box and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports within maximum spacings indicated.
- D. All void spaces within or around sleeves shall be filled with approved fire sealant.

END OF SECTION 16190

SECTION 16452 - GROUNDING AND GROUND-FAULT PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification section apply to work of this section.
- B. Division 16 Basic materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Extent of grounding and ground-fault protection work is indicated by drawings and schedules.
- B. Types of grounding and ground-fault protection in this section include the following:
 - 1. Grounding:
 - a. Metal building frames
 - b. Separately derived systems
 - c. Enclosures
 - d. Systems
 - e. Equipment
 - 2. Ground-Fault Protection:
 - a. Ground-fault circuit interrupters
- C. Requirements of this section apply to electrical grounding and ground-fault protection work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of grounding and ground-fault protection units of types and ratings required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with grounding and ground fault installation work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to electrical grounding and ground-fault protection systems.

- D. ANSI/IEEE Compliance: Comply with C114.1 (IEEE Std 142) and IEEE Stds Nos. 241 and 242 pertaining to grounding and ground-fault protection of power systems.
- E. ANSI/UL Compliance: Comply with requirements of ANSI/UL and UL standards pertaining to grounding and ground-fault protection equipment and devices. Provide products which have been UL-listed and labeled.
- F. NEMA Compliance: Comply with NEMA Stds Pub Nos. PB 1.2 and AB 1, pertaining to construction and installation of ground-fault protection devices and molded-case circuit breakers.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on grounding and ground-fault protection equipment and devices.
- B. Maintenance Data: Submit maintenance instruction and spare parts lists. Include this data in maintenance manuals.

PART 2 PRODUCTS

2.1 GROUNDING

- A. Materials And Equipment:
 - 1. Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cable/wires, connectors, terminals (solderless lugs), bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for application indicated.
 - 2. Provide conduit, duct and fittings complying with Division 16 Basic Materials and Methods section, "Raceways", in accordance with the following listing:
 - a. Rigid steel conduit
 - b. Electrical metallic tubing
 - c. Flexible metal conduit, Type 2
 - d. Liquid-tight flexible metal conduit
 - e. Rigid metal conduit fittings
 - f. EMT fittings, Type 1
 - g. Flexible metal conduit fittings
 - h. Liquid-tight flexible metal conduit fittings

- B. Electrical Grounding Conductors:
 - 1. Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. All grounding conductors shall be copper.
- C. Bonding Plates, Connectors, Terminals and Clamps:
 - 1. Provide electrical bonding plates, connectors, terminals and clamps as recommended by bonding plate, connector, terminal, and clamp manufacturer's for indicated applications.

2.2 GROUND FAULT PROTECTION DEVICES

- A. General: Except as otherwise indicated, provide ground-fault protection devices and components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.
- B. Circuit Interrupters/Circuit-Breakers: Provide 1" wide module bolt-on panelboard circuit breakers, with integral ground-fault circuit interrupters, UL-rated Class A, Group 1; with ampacity rating, pole construction, voltage and asymmetric interruption capacity as shown on the drawings. Provide with solid-state ground-fault sensing and signaling, with 5 milliamperes ground-fault sensitivity, +/-1 milliamperes. Equip with PUSH-TO-TEST capability. Provide modules which fit panelboards in which they are located.
- C. Manufacturer: Subject to compliance with requirements, provide ground-fault circuit interrupters of one of the following:
 - 1. Cutler-Hammer
 - 2. General Electric Company
 - 3. Square D Company

PART 3 EXECUTION

3.1 INSTALLATION OF GROUNDING AND GROUND-FAULT PROTECTION SYSTEMS

- A. Install electrical grounding systems and ground-fault protection devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding and ground-fault protection devices comply with requirements. Comply with requirements of NEC, NESC, and NEMA standards for installation of grounding and ground-fault protection systems and devices.
- B. Coordinate with other electrical work as necessary to interface installation of grounding system and ground-fault protection devices with other work.

- C. Install clamp-on connectors only on thoroughly cleaned metal contact surface, to ensure electrical conductivity and circuit integrity.
- D. All wire used on the load side of branch GFCI protective devices shall be Type XHHW, XLP, or equivalent. Wiring pulling compound shall not be used on this wiring to facilitate installation.
- E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- F. Size and type of green equipment ground conductors and method of securing them to obtain electrical continuity and effective grounding as per National Electrical Code, Article 250. Conduit shall not be used for the primary grounding means, but shall be electrically continuous for use as a supplemental grounding system.
- G. Neutrals of lighting systems shall be grounded independently and in accordance with the National Electrical Code.
- H. All metal raceway system, including cabinets, conduit and boxes, shall be grounded to a water pipe with UL approved grounding clamp in accordance with the National Electrical Code.
- I. An equipment ground conductor shall be installed in all conduits.

3.2 TESTING

- A. Upon completion of installation of ground-fault protection devices and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then re-test to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
- B. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 3 ohms, take appropriate action to reduce resistance to 3 ohms or less by driving additional ground rods and/or by chemically treating soil encircling ground rods with sodium chloride, calcium chloride, copper sulfate, or magnesium. Then re-test to demonstrate compliance.

END OF SECTION 16452

SECTION 16475 - SURGE SUPPRESSION

PART 1 GENERAL

1.1 DESCRIPTION: The Electrical Contractor shall furnish all labor, materials, equipment and services necessary for and incidental to the installation of the Transient Voltage Surge Suppression (TVSS) System. Components are as specified herein.

1.2 RELATED DOCUMENTS AND APPLICABLE STANDARDS

- A. Systems shall be designed, manufactured, tested, and installed in accordance with the latest edition of the following standards:
 - 1. Underwriters Laboratories (UL 1449, Second Edition)
 - 2. National Electrical Manufacturers Association (LS 1)
 - 3. American National Standards Institute (C62.41)
 - 4. Institute of Electrical and Electronic Engineers (Std 1100)
 - 5. Military Standards (MIL-STD 220A)
 - 6. National Electrical Code (Article 285)
- B. The system shall be UL 1449 listed as a complete system under the UL 1449 standard for Transient Voltage Surge Suppressors. Systems not UL 1449 listed are not acceptable.

1.3 SUBMITTALS

- A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
- B. Equipment Manual: The manufacturer shall furnish an installation manual with installation, start-up, and operating instructions for the specified system.
- C. UL 1449 Ratings: Documentation of specified system's UL 1449 listing and suppressed voltage ratings (SVR) shall be included as required product data submittal information.
- D. Maximum Surge Current Test Reports demonstrating that the TVSS has been tested to the specified rating. Reports will clearly demonstrate that the tests have been performed on a COMPLETE device including all necessary fusing, disconnects, monitoring systems, etc.
- E. Minimum Repetitive Surge Current Rating. Provide data demonstrating that the device is capable of surviving the minimum specified repetitive rating.
- F. Short Circuit Current (AIC). Provide test reports demonstrating that the device has been tested to the specific AIC rating.
- G. Full NEMA LS1 data package per the requirements of this standard.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements and subject to providing the required submittal data, provide devices of one manufacturer:
 - 1. Innovative Technology, Inc.
 - 2. L.E.A. International
 - 3. Liebert Corporation

2.2 EQUIPMENT

- A. Equipment shall be a parallel protector rated for 3 phase, 4 wire applications.
- B. The equipment maximum surge current capacity, based on an 8 x 20 microsecond waveform per ANSI/IEEE C62.41 Category C3 rating, shall be a minimum of 125,000 amps per mode.
- C. The TVSS shall be capable of withstanding over 15,000 sequential 10,000 Amp ANSI/IEEE C62.41 Category C3 impulses without degradation or failure. Manufacturers will provide a higher maximum surge current rating in order to meet the repetitive (longevity) requirements in this paragraph.
- D. Each module must have an indicator light to report status of the module. A corresponding indicator must be mounted on the front of the panel.
- E. Protection modes: The TVSS shall provide Line to Ground (L-G), Line to Line (L-L), Line to Neutral (L-N), and Neutral to Ground (N-G) protection.
- F. Status alarm monitor, surge counter, audible alarm and remote status monitors shall be provided. The TVSS will also be equipped with a built-in push-to-test feature that tests the integrity of each MOV/fuse pair.
- G. The system performance ratings shall be based on the UL 1449, Second Edition Suppressed Voltage Rating (SVR). The maximum UL 1449 SVR for each of the specified protection modes shall be:
 - 1. 700 volts L-N for 277/480 volt systems.
 - 2. 330 volts L-N for 120/208 volt systems.

PART 3 EXECUTION

3.1 INSTALLATION OF THE TVSS SYSTEMS

- A. The preferred specified system shall be installed within the gear protected, but if submitted as a separate unit, to be installed no further than 3 feet in total wire lead length(s) distance from the power conductor(s) it is protecting and shall avoid any unnecessary bends. Terminals shall be provided for all necessary power and ground connections.
- B. The specified system shall be provided with an internal safety interlocked disconnect system providing no interruption to the protected load for testing and maintenance. System shall not require removal and replacement for warranty or other repairs. All internal component replacements shall be capable of being completed by a licensed electrician.
- C. Other materials and equipment shall comply with applicable Sections of this Division.

3.2 TESTING

- A. Conduct manufacturer's standard factory tests per approved submittal data.
- B. Submit formal report of factory tests within 10 days of factory tests, stating tests conducted, acceptable limits of such tests, actual test results, and original test data sheet with legible signatures of those conducting, witnessing, and approving such tests.
- C. The system shall be tested to MIL-STD 220A for electrical line noise attenuation

per 50 ohm insertion loss measurement method of radio frequencies up to 100 MHz.

3.3 WARRANTY

- A. Manufacturer shall provide a product warranty for a period of not less than 5 years from date of installation. Warranty shall cover unlimited replacement of system protection modules during the warranty period.

END OF SECTION 16475

SECTION 16510 - INTERIOR BUILDING LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Division 16 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Extent of interior lighting fixture work is indicated by drawings and schedules.
- B. Types of interior lighting fixtures in this section include the following:
 - 1. Fluorescent
 - 2. Incandescent
 - 3. HID
 - 4. Compact Fluorescent
- C. Applications of interior lighting fixtures required for project include the following:
 - 1. General lighting
 - 2. Supplementary lighting
 - 3. Task lighting
 - 4. Emergency lighting
- D. Lighting Control
 - 1. Relay Panels
 - 2. Occupancy Sensors

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of interior lighting fixtures of types, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with interior lighting fixture work similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to installation and construction of interior building lighting fixtures.
- D. NEMA Compliance: Comply with applicable requirements of NEMA Std Pub. Nos. LE1 and LE2 pertaining to lighting equipment.”
- E. ANSI/IES: Comply with ANSI 132.1 pertaining to interior lighting fixtures.
- F. ANSI/UL Compliance: Comply with ANSI/UL standards pertaining to interior lighting fixtures for hazardous locations.
- G. UL Compliance: Provide interior lighting fixtures which have been UL-listed and labeled.
- H. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association Standards and carry the CBM label.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on interior building lighting fixtures
- B. Shop Drawings: Submit dimensioned drawings of interior lighting fixtures installations, including but not necessarily limited to, layout, relation to associated panelboards, and connections to panelboards. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data in maintenance manuals.
- D. Maintenance Stock: Submit the following items of maintenance stock prior to substantial completion:
 - 24 fluorescent lamps of each type
 - 12 incandescent lamps of each type
 - 2 each of each other type of lamp

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of manufacturers as listed in the lighting fixture schedule.

2.2 INTERIOR LIGHTING FIXTURES

- A. General: Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters and wiring.
- B. Fluorescent-Lamp Ballasts: Provide high efficiency energy-saving electronic technology type fluorescent-lamp ballasts, capable of operating lamp types indicated; with high power factor, Class P sound rated A, THD less than 10%, crest factor less than 1.7, 90% power factor or more, shall withstand line transients as defined in ANSI/IEEE C62.41 (Category A), shall have a frequency of operation of 20 KHZ or greater, shall meet FCC Rules and regulations, Part 18, Class A, and low-noise features; sound-rated A, and with internal thermal protection; similar and equivalent to Motorola, Advance or Magnetek.
 - 1. Ballasts for 4 lamp operation shall be parallel type.
- C. Compact Fluorescent Lamp Ballasts: Provide high efficiency electronic ballast capable of operating lamp types specified, with high power factor, low noise, sound rated A, THD of 10% with internal thermal protection. Provide Motorola, Advance, or Magnetek. Compact fluorescent ballast as manufactured by ESI will not be accepted.
- D. High Intensity Discharge (HID) Ballast:
 - 1. Description: ANSI C82.4, HID ballast as required
 - 2. Provide ballast suitable for lamp specified
 - 3. Voltage: Match luminaire voltage
- E. Emergency Ballasts:
 - 1. All emergency ballasts shall be equal to Bodine B-50ST with a 5 year warranty.

- F. Interior Lighting Fixture Types:
1. Interior lighting fixture types are scheduled on the drawings.
- G. Lamps: T8 type:
1. Phillips "Alto"
2. Osram Sylvania "Eco"
3. GE "Ecolux"
- Color temperature of lamps shall be as indicated in fixture schedule on drawings. All lamps to be designated as "low mercury" content meeting all federal TLCP requirements.
- H. HID Lamps:
1. Acceptable Manufacturers:
a. General Electric
b. Phillips
c. Osram Sylvania
2. All HID lamps to be color corrected for color uniformity (CRI > 85). All lamps to match in stock lot, color, lumens per watt, mounting position, manufacturer, etc.
- I. Exit Signs:
1. Manufacturers: As schedules on Drawings
2. Description: Exit sign fixture
3. Housing: High-impact thermoplastic
4. Face: As scheduled on Drawings
5. Directional Arrows: As indicated on Drawings
6. Mounting: As indicated on Drawings
7. Battery: As scheduled on Drawings
8. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within 12 hours.
- J. Relay Panels:
1. Relay panel shall be populated with up to 24 relays and provided with Network or Remote control module.
2. Relay panel to meet or exceed specifications equal to Lithonia Z-Max relay panel.
- K. Occupancy Sensors:
1. Occupancy Sensors to meet or exceed specifications equal to Lithonia.

PART 3 EXECUTION

3.1 INSTALLATION OF INTERIOR LIGHTING FIXTURES

- A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of interior lighting fixtures with other work.
- C. Fasten fixtures securely to indicated structural support; and check to ensure that

solid pendant fixtures are plumb.

- D. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire. Final connection to light fixture from junction box shall be made in flexible conduit (6' maximum length). Flexible conduit connections between fixtures will not be accepted.
- E. Bond products and metal accessories to branch circuit equipment grounding conductor.
- F. Install specified lamps in each luminaire, emergency lighting unit and exit sign.
- G. All fixtures shall be guaranteed for a period of one year after final acceptance and any defects in material or workmanship during this period shall be replaced or repaired to the Architect's satisfaction without extra cost.
- H. All supports, safety chains, swivels, etc. shall be furnished as required for a complete installation.
- I. Install all lamps in fixtures of contiguous spaces with the same lot, type and color lamp. Install all lamps at the same time for consistent burn in and operation.

3.2 ADJUST AND CLEAN

- A. Clean interior lighting fixtures of dirt and debris upon completion of installation and touch up damage.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Aim and adjust luminaries as indicated on drawings or as directed.
- D. Adjust exit sign directional arrows as indicated.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of interior lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- B. Group relamp luminaries in contiguous space if any fixtures have failed lamps at substantial completion. Fluorescent lamps that fail within the first 90 days of operation will be considered defective and shall be replaced at no extra cost.

3.4 GROUNDING

- A. Provide secure equipment grounding connections for each interior lighting fixture installation where indicated.

END OF SECTION 16510

SECTION 16670 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Strike (air) terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

1.2 RELATED REQUIREMENTS

- A. Section 16452 - Grounding and Bonding for Electrical Systems: Electrical system grounds.
- B. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.3 REFERENCE STANDARDS

- A. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2020.
- B. UL 96 - Lightning Protection Components Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
 - 1) Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.
 - 2) If concrete-encased grounds are to be used and are not shown in Contract Documents, provide sufficient data to determine concrete encasement dimensions and location.
 - 3) Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.
 - 4) Include engineering analysis of equalization of potential to metal bodies within the structure.
 - 5) Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.
 - 6) Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 7) Installation Certification: Submit copy of certification agency's approval.
 - 8) Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced system design standard on site.
- B. Manufacturer Qualifications: Company specializing in lightning protection equipment with minimum three years documented experience.
- C. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years documented experience.
- D. Installer Qualifications: Capable of providing the specified certification of the installed system.
- E. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LIGHTNING PROTECTION COMPONENTS:

- 1) Harger Lightning and Grounding
- 2) National Lightning Protection Corporation
- 3) Robbins Lightning, Inc
- 4) thermOweld, subsidiary of Continental Industries; division of Burndy LLC:

B. LIGHTNING PROTECTION SYSTEM

- 1) Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.

- 2) PROVIDE SYSTEM THAT PROTECTS:

- i. The entire structure.
- ii. Open air areas within 100 feet of exterior walls at grade level.
- iii. Open air areas within building footprint.
- iv. Coordinate with other grounding and bonding systems specified.
- v. Treat isolated non-grounded protruding metal items as specified by NFPA 780 for heavy-duty stacks.
- vi. Determine ground resistance by field measurement.
- vii. Provide copper, bronze, or stainless steel components, as applicable; no aluminum.
- viii. Provide system certified by Underwriters Laboratories or the Lightning Protection Institute.

- b) Strike Terminals: Provide strike (air) terminals on the following:

- i. Roofs.
- ii. Penthouse roofs.
- iii. Parapets.
- iv. Roof mounted equipment.
- v. Stacks.

- 3) COMPONENTS

- a) All Components: Complying with applicable requirements of UL 96.
- b) Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.
- c) Grounding Rods: Solid copper.
- d) Ground Plate: Copper.
- e) Conductors: Copper cable.
- f) Connectors and Splicers: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Coordinate work with installation of roofing and exterior and interior finishes.

3.2 INSTALLATION

- A. Install in accordance with referenced system standards and as required for specified certification.
- B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.
- C. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.
- D. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

END OF SECTION 16670

SECTION 16721 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to work of this section.
- B. Refer to applicable Division 15 section for duct detectors at air handling units and subsequent control requirements of all motors, smoke dampers, and other pertinent HVAC equipment.
- C. The complete installation shall conform to the applicable section of NFPA-101, Local Code Requirements and National Electrical Code with particular attention to Article 760.

1.2 DESCRIPTION OF WORK

- A. The work covered by this section of the specifications includes the furnishings of all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the drawings and as herein specified.
- B. Types of fire alarm and detection systems in this section include the following: Combination, Zoned, Non-Coded, and Addressable.

1.3 QUALITY ASSURANCE:

- A. **Manufacturers:** A firm regularly engaged in manufacturer of fire alarm and detection systems, of types and sizes, and electrical characteristics required, whose products have been in satisfactory use in similar service for no less than 5 years. Each and all items of the Fire Alarm Systems shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable to comply with UL864 requirements.
- B. **Installer:** Qualified with at least 5 years of successful installation experience on projects with fire alarm and detection system installation work similar to that required for project.
- C. **Code Compliance:** Comply with all NFPA Requirements as applicable to construction and installation of fire alarm and detection components and accessories.
- D. **UL Compliance and Labeling:** Provide fire alarm and detection system components which are UL-listed and labeled.
- E. **FM Compliance:** Provide fire alarm and detection systems and accessories

which are factory mutual approved.

1.4 SUBMITTALS

A. General:

1. Material and documentation submitted shall be in accordance with Sections 01300 and 16010.
2. Incomplete or partial submittals will not be reviewed nor approved until all requested items are provided to the A/E. Completeness of the submittal is the sole responsibility of the Contractor.
3. Sufficient information, clearly marked, shall be presented in order for the reviewer to determine compliance with contract documents. Unmarked submittals shall be returned un-reviewed.
4. Equipment proposed shall be from one (and only one) of the companies listed under "ACCEPTABLE MANUFACTURERS". Proposed substitute equipment will not be reviewed by the A/E.
5. A complete submittal shall contain:
 - a. Product Descriptions,
 - b. Floor Plans, and
 - c. O & M Manual.

B. Product Descriptions:

1. Provide manufacturer's standard catalog sheets for fire alarm system devices proposed. This shall include (but not limited to) smoke detectors, heat detectors, control modules, and notification appliances.
2. Each item proposed shall be clearly marked with complete part numbers.

C. Floor Plans:

1. Provide large scale drawings (24" x 36" or 32" x 42"). Drawings shall be produced with a "CAD" program. Photocopies floor plans from the contract document set is unacceptable. 8-1/2" x 11" drawings are also unacceptable.
2. Floor plans shall show as a minimum: 1/8 scale walls, rooms with names and numbers, fire alarm device locations, symbol legend, conduit (if applicable) routing, junction box (if applicable) locations, wire and cable types and counts.

D. O & M Manuals:

1. Manuals shall be bound into "book" form and marked "O & M Fire Alarm

System Manual".

2. Manuals shall contain system operating information along with component technical sheets.
3. Manuals shall contain system component interconnection wiring diagrams marked as applicable for this project. General wiring diagrams are unacceptable.
4. Manuals shall provide clear and concise information on such items (but not limited to):
 - a. Basic Troubleshooting
 - b. Contact Information for Repair and Maintenance

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Products in this specification are based on Simplex Grinnell herein described and as indicated on the drawings and was basis of design.
 1. EST
 2. Siemens
 3. Simplex Grinnell

2.2 FIRE ALARM AND DETECTION SYSTEMS

- A. General:
 1. Furnish and install devices as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition. Include sufficient Zone Adapter Modules, addressable manual stations, automatic fire detectors, smoke detectors, duct detectors, audible and visual signal devices, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
 2. All peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The catalog numbers specified under this section are those of Simplex Time Recorder Co. and constitute the type, product quality, material, and desired operating features.
- B. Fire Control Panel: The Fire Alarm Control Panel is an existing Simplex 4020.
- C. Remote Annunciators: Where shown on the plans, provide and install an LCD annunciator. The annunciator(s) shall be recessed mounted in a six gang backbox and provide 2 lines of 40 characters display. The display shall be "back lighted" with LED's. The annunciator shall be provided with front panel control

switches for SYSTEM ACKNOWLEDGE, ALARM SILENCE, and SYSTEM RESET. Four programmable switches shall also be provided. The annunciator shall communicate over the system shielded twisted pair cable. Point wired annunciators are not acceptable. The annunciator shall be 24 VDC powered from the fire alarm control panel. Provide annunciator(s) equivalent to Simplex #4603-9101.

- D. Multiple Addressable Peripheral Network (MAPNET): Wiring types will be approved by the equipment manufacturer. Existing wiring will be utilized in retrofit applications. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Class B circuit. Class A communications will be provided where shown on the drawings. Wire will be so routed to maintain sufficient distance between the forward and return loop as called for by the authority having jurisdiction. To minimize wire routing and to facilitate future additions, t-tapping of the communications channel will be supported except where Class A wiring is required.
- E. Materials and Equipment:
1. The addressable devices specified below must be capable of communicating with the existing system control panel. The location of addressable devices will be selected along with conventional devices to optimize the system layout in order to provide the level of protection, zone identification and control as shown on the drawings.
 2. All addressable smoke and heat detector heads as specified below will be pluggable into their bases. The base will contain electronics that communicate the detector status (normal, alarm, trouble) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Different detector heads (smoke or heat) must be interchangeable. Upon removal of the head a trouble signal will be transmitted to the control panel.
 3. Addressable Pull Stations: Addressable pull stations will contain electronics that communicate the station's status (alarm, normal) to the FACP over 2 wires which also provide power to the pull station. The address will be set on the station. They will be manufactured from high impact red Lexan. The station will mechanically latch upon operation and remain so until manually reset by opening with a key combo to all system locks. Pull stations will be single action, #2098-9784 with trim plate in matching red. Mounting height shall be 48-inches above finish floor unless noted otherwise.
 4. Zone Adapter Module: Zone Adapter Modules shall be used for monitoring of water flow, valve tamper, non-addressable smoke and heat detectors, and for control of alarm indicating appliances, AHU systems, and magnetically held doors.
 - a. An addressable interface module shall be provided for interfacing normally open direct contract devices to an addressable initiating circuit. The device shall be a Simplex type Zone Adapter Module

(ZAM).

- b. ZAM's will be capable of mounting in a standard electric outlet box. ZAMs will include cover plates to allow surface or flush mounting. ZAMs will receive their 24VDC power from a separate two wire pair running from an appropriate power supply.
- c. There shall be two types of devices:
 - 1) Type 1: Monitor ZAM
 - 2) Type 2: Control ZAM
- d. For Type 1 above:
 - 1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. This type of addressable device module will provide power to and monitor the status of a zone consisting of conventional 2-wire smoke detectors and/or N/O contact devices as specified elsewhere. The supervision of the zone wiring will be Class B. These ZAMs will communicate the zone's status (normal, alarm, trouble) to the FACP. Model #2190-9155/56 for surface/flush mounting.
 - 2) For conventional 4-wire smoke detector with Class B wiring supervision. This type of addressable device will provide power to and monitor the contact status of a zone consisting of conventional 4-wire smoke detectors as specified elsewhere. The ZAM will provide detector reset capability and a 2 ampere fuse to 4-wire detector. These ZAMs will communicate the zone's status (normal, alarm, trouble) to the FACP. Model #2190-9157/58 for surface/flush mounting.
- e. For Type 2 above:
 - 1) Zone Adapter Module: For chimes and strobe signals signal devices. This type of addressable device will provide double pole double throw relay switching that can be used to connect through easily replaceable 2 amp fuses: a zone of signals to a power source; speakers to an audio source; fire fighter phone jacks to a communications channel or activate a variety of controlled devices. The module will be available in either a Class B or Class A supervision version. In the Class B version the wiring will be supervised by an end-of-line device. Class B devices will be provided. These ZAMs will communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and will receive a command to transfer the

relay from the fire alarm control panel. Model #2190-9161-62 for surface/flush mounting.

- 2) Zone Adapter Module: For non-suppressed control. This type of addressable device will provide double pole double throw relay switching for loads up to 120 VAC. It will contain easily replaceable 2 amp fuses, one on each common leg of the relay. The ZAM shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the ZAM become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel. The ZAM shall be capable of being programmed for its "Address" location on the addressable device initiating circuit. The ZAM shall be compatible with addressable manual stations and addressable detectors on the same addressable initiating circuit. Model #2190-9163/64 for surface/flush mounting.
5. Photoelectric Smoke Detector. Provide type 2098-9201 Photoelectric Smoke detector heads with type 2098-9637 bases as shown on the plans. Detectors shall be of the solid state photoelectric type utilizing a stable LED light source and a silicone photo diode as the receiving element to form a highly accurate means of smoke detection. Internal detector circuits shall be shielded against electrical interference and resistant to transients, "noise and RF interference". Nominal detector sensitivity shall be 1.4% per foot obstruction with a range of 1% to 1.84%. Regardless of sensitivity settings, the detector's stability shall be unaffected by high air velocity. No radioactive materials shall be used.
6. Heat Detector: Automatic heat detectors shall be combination rate or rise and fixed temperature type. When the fixed temperature portion is activated, the units shall be non-restorable and give visual evidence of such operation. Heat detectors shall be Simplex Type 2098-9400 series.
7. Audiovisual Chime-Strobe:
 - a. Chimes: Chimes shall be Simplex type 2902-9207. The chime shall be polarized and shall be operated by 24 VDC with a minimum of 82 dB at 10 ft. Adaptors shall allow surface, semi-flush, weather resistance, or audio/visual mounting as shown on the plans. It shall provide 4 connections to insure properly supervised in/out system connection. Chime motor shall be capable of accepting chime kit or bell gong without replacement of entire unit. Chime shall be UL Listed for its intended purpose. Mounting height shall be 7' - 0" above finish floor unless noted otherwise.
 - b. Visual Flashing Lamps (Xenon Strobe): Visual indicating

appliances shall be Simplex type 4903-9101 and comprised of a Xenon flashtube and be entirely solid state. The devices shall be UL listed and be capable of either ceiling or wall mounting. Flashing lamp shall be mounted below and connected to the chime unit.

8. Magnetic Door Holder: Magnetic door holders shall be Simplex type 2088-9554 and shall have an approximated holding force of 35 lbs. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Unit shall be semi-flush mounted. Door holders shall be UL Listed for their intended purpose. Mounting height shall be 6'-6" unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall provide and install the system in accordance with the plans and specifications, all national and local applicable codes, NEC wiring criteria, and the manufacturer's recommendations. All communications wiring shall be twisted and shielded cables. All wiring shall be in a conduit system separate from other building wiring. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the scope of work. All junction boxes larger than 4 inches square shall be provided with terminal strips for all wire splices and terminations.
- B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. The manufacturer's authorized representative shall provide all on-site software modifications and supervision of installation of the complete Fire Alarm System installation, perform a complete functional test of the system, and submit a written report to the Contractor attesting to the proper operation of the completed system.

3.2 TESTING

- A. The completed fire alarm system shall be fully tested by the Contractor in the presence of the Owner's representative, the Architect, the Consulting Engineers, the local authority having jurisdiction, and the manufacturer's technical representative. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner, Engineer, and General Contractor.

3.3 WARRANTY

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of 1 year from the date of the completed and certified test. The equipment manufacturer shall make available to the Owner, a maintenance contract proposal to provide a minimum of 2 inspections and tests per year following the criteria of NFPA-72H.

3.4 INSTRUCTION MANUALS

- A. The Contractor shall provide, in addition to one approved copy of the fire alarm system submittal; pertinent system orientation documents, and system service, testing, and alarm documentation in the fire control area for the Owner's and Fire Department's permanent use.

END OF SECTION 16721

SECTION 16880 - SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

1.2 The requirements for Zone 1 seismic protection measures to be applied to electrical equipment specified herein are in addition to any other items called for in other sections of these specifications. The electrical equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

- A. Control Panels
- B. Light Fixtures
- C. Switchboards (Floor Mounted)
- D. Transformers
- E. Conduit 2-1/2" Inside Diameter and Bigger

F. APPLICABLE PUBLICATIONS

1.3 Federal Specifications:

- A. RR-W-410D

1.4 American National Standards Institute, Inc. (ANSI):

- A. B18.2.1-1981
- B. B1B.2.2-1972

1.5 American Society for Testing and Materials (ASTM):

- A. A36-84a
- B. A307-84
- C. A325-85
- D. A501-84
- E. A576-81

PART 2 PRODUCTS

2.1 Sway brace of structural steel conforming with ASTM A36.

2.2 Mechanical couplings of the sleeve type to provide a tight flexible joint under all reasonable conditions.

- 2.3 Underground bolts conforming to ASTM A325.
- 2.4 Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B12.2.2 and ASTM A307 or 306.
- 2.5 Guy wires where required shall conform to Fed Spec. RR-W-441 as follows:
 - 1) 5/32" diameter Type V, Class 1
 - 2) 3/16" to 5/16" diameter Type V, Class 2
 - 3) 1/4" to 5/8" diameter Type I, Class 2

PART 3 EXECUTION

- 3.1 All underground conduit 2" and larger shall have flexible couplings installed adjacent to building. Additional flexible couplings shall be provided as follows:
 - A. On each side of the joints of demarcation between soils having widely differing degrees of consolidation.
 - B. At all points that can be considered to act as anchors.
 - C. All rigidly mounted equipment will have a minimum of 4 anchor bolts securely fastened through bases. Anchor bolts must conform to ASTM A307. Anchor bolts shall have an embedded straight length equal to at least twelve times the nominal diameter of the bolt and shall conform to the applicable tables for various equipment weights.

<u>Maximum Equipment Weight (Pounds)</u>	<u>Zone 1</u>
500	1/2
1,000	1/2
5,000	1/2
10,000	1/2
20,000	1/2
30,000	1/2
50,000	1/2
100,000	1/2

- 1) Based on 4 bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Use equivalent total cross-sectional area when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation

shall be increased in depth to accommodate bolt lengths.

- 2) When height-to-width ratio of the equipment exceed 8.9, overturning must be investigated. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure, except that an equipment weight shall be used. Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.
- 3.2 Equipment Sway Bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree angle from the equipment frame to the building structure secured at both ends with no less than 1/2" bolts. Braces shall conform to all applicable codes and standards for Seismic Zone Classification. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45-degrees, provided that supporting members are properly sized to supporting operating weight of equipment when inclined at a 45-degree angle.
 - 3.3 Lighting fixtures and supports will conform to the following:
 - A. Fixture supports shall be malleable iron.
 - B. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
 - C. Recessed fluorescent individual or continuous-row fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be bolted thereto at each corner of the fixture; or shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures and one wire per unit of continuous row fixtures.
 - D. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting fixtures on 4" boxes, 3" plaster rings, and fixture studs.
 - E. Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissors clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of the structural slab shall be properly anchored to the slab at each corner of the fixture.
 - F. Each wall-mounted emergency light unit shall be secured in a manner to hold the

unit in place during a seismic disturbance.

- 3.4 In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture-supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixtures supports satisfy the requirements given herein.
- A. To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately one cycle per second. The exact number of cycles per second and the actual dimensions of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.07g. The actual fixture-mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions, ranging from parallel to perpendicular to the line of traverse.
 - B. All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1-minute duration with the mounting surface in the line of traverse, at 45-degrees to the line of traverse, and at 90-degrees to the line of traverse. A total of two fixtures shall be tested in each of the above positions. After each of the six tests, the complete stem assemblies from fixtures having stem assemblies shall be subjected to a tensile strength test. The same shall withstand, without failure, a force of not less than four times the weight it is intended to support.
 - C. No component of a fixture nor its supports shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.
 - D. In lieu of the above test requirements, lighting fixtures shall be designed to resist a lateral force of 28 percent of the fixture weight.
- 3.5 Lighting fixture shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:
- A. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendant-hung fixtures not over 20 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws, bolts, or clips.
- 3.6 The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.06 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.
- A. Transformers

B. Switchboards and Switchgear

C. Free Standing Electric Motors

END OF SECTION 16880

