

November 4, 2018

Project Specifications

IRC-1728 Indian River County Courthouse Renovations Project

Indian River County Courthouse
2000 16th Avenue
Vero Beach, Florida 32960



Architect:
PGAL
791 Park of Commerce Blvd.
Suite 400
Boca Raton, Florida 33487

TABLE OF CONTENTS

COVER

TABLE OF CONTENTS

DIVISION 0 – BIDDING AND CONTRACT REQUIREMENTS

REFER TO INDIAN RIVER COUNTY TABLE OF CONTENTS IN THIS SECTION

DIVISION 1 - GENERAL REQUIREMENTS

REFER TO INDIAN RIVER COUNTY TABLE OF CONTENTS IN THIS SECTION

DIVISION 2 – EXISTING CONDITIONS

024119 SELECTIVE DEMOLITION

DIVISION 3 – CONCRETE

033000 CAST-IN-PLACE CONCRETE

DIVISION 4 – MASONRY

042200 CONCRETE UNIT MASONRY

DIVISION 5 - METALS

054000 COLD-FORMED METAL FRAMING

DIVISION 6 – WOOD, PLASTIC AND COMPOSITES

061000 ROUGH CARPENTRY
062023 INTERIOR ARCHITECTURAL WOODWORK
064214 WOOD PANELING

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

072100 THERMAL INSULATION
078413 PENETRATION FIRESTOPPING
078443 JOINT FIRESTOPPING
079200 JOINT SEALANTS

DIVISION 8 - OPENINGS

081113 HOLLOW METAL DOORS AND FRAMES
081416 FLUSH WOOD DOORS
083113 ACCESS DOORS AND FRAMES

083220	STEEL DETENTION DOORS AND FRAMES
083460	SOUND CONTROL DOORS
087100	DOOR HARDWARE
087810	DETENTION DOOR HARDWARE
088000	GLAZING

DIVISION 9 - FINISHES

092216	NON-STRUCTURAL STEEL FRAMING
092900	GYPSUM BOARD
093013	CERAMIC TILING
095113	ACOUSTICAL PANEL CEILINGS
096513	RESILIENT BASE AND ACCESSORIES
096519	RESILIENT TILE FLOORING
096813	TILE CARPETING
099123	INTERIOR PAINTING

DIVISION 10 - SPECIALTIES

102800	TOILET, BATH AND LAUNDRY ACCESSORIES
104410	FIRE-PROTECTION CABINETS AND EXTINGUISHERS
106710	METAL STORAGE SYSTEMS
106720	MECHANICAL ASSIST STORAGE SYSTEMS

DIVISION 23 – MECHANICAL

230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230529	HANGERS AND SUPPORTS FOR HVAC EQUIPMENT
230548	VIBRATION CONTROLS FOR HVAC
230553	IDENTIFICATION FOR HVAC EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233600	AIR TERMINAL UNITS
233713	DIFFUSERS, REGISTERS, AND GRILLES

DIVISION 26 – ELECTRICAL

260010	BASIC ELECTRICAL REQUIREMENTS
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260923	LIGHTING CONTROL DEVICES
262726	WIRING DEVICES
262813	FUSES

262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
265119	LED INTERIOR LIGHTING
265219	EMERGENCY AND EXIT LIGHTING

DIVISION 27- LOW VOLTAGE

270010	TECHNOLOGY GENERAL CONDITIONS
270526	GROUNDING AND BONDING FOR TELECOMMUNICATIONS SYSTEM
270528	RACEWAYS FOR TECHNOLOGY
271000	STRUCTURED CABLING SYSTEM
274100	AUDIO/VISUAL SYSTEMS

DIVISION 31- EARTHWORK

313116	TERMITE CONTROL
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END OF TABLE OF CONTENTS

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SECTION 024119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Repair procedures for selective demolition operations.
- B. Related Sections include the following:
 - 1. All instructions for Procedures, Work Restrictions, Security Clearances as outlined by Owner in Division 1 and other documents in these Specifications.
 - 2. All Sections of these Specifications where new work is to occur and Selective Demolition shall be required.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Construction Manager's property and shall be removed from Project site.
- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
 - 1. Coordinate with Owner who will establish special procedures for removal and salvage.

1.5 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Courthouse operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

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

- B. Professional Engineer Qualifications: Comply with Division 1 Section "Quality Requirements."
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site prior to start of demolition work.

1.7 PROJECT CONDITIONS

- A. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- B. Owner assumes no responsibility for condition of areas to be selectively demolished.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- D. Storage or sale of removed items or materials on-site will not be permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped as may be required for this project.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 14 days notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. The Owner will arrange to shut off Owner provided utilities when requested by Contractor, if required.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- D. Utility Requirements: Refer to Division 22, 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective

demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. **Dangerous Materials:** Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. **Pest Control:** Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations, as needed.
- C. **Site Access and Temporary Controls:** Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 5. Any site work damaged shall be restored to original condition.
- D. **Temporary Facilities:** Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Coordinate Life Safety Plan with Owner and Architect prior to beginning work.

3.4 POLLUTION CONTROLS

- A. **Dust Control:** Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. **Disposal:** Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. **Cleaning:** Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

- D. Noise Control: Construct Acoustical Barriers around areas of work to prevent noise from entering other parts of the building.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain adequate ventilation when using cutting torches.
 - 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 7. Dispose of demolished items and materials promptly.
 - 8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.
- C. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section and all Owner requirements.
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Contractor to provide dumpster on site at location coordinated with Owner.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
- D. Coordinate with Project Manager all items to be salvaged and turned over to Owner.

END OF SECTION 024119

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SECTION 033000

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Slabs-on-grade. (Patching of slabs)
- B. Related Sections:
 - 1. Section 024119 "Selective Demolition".

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, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. 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, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

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

- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Floor and slab treatments.
 - 5. Vapor retarders.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. 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."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, 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-1 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.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Deformed-Steel Wire: ASTM A 496/A 496M.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
 - D. Water: ASTM C 94/C 94M and potable.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, available products or equal that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra 10.
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Insulation Solutions, Inc.; Viper VaporCheck 10.
 - e. Meadows, W. R., Inc.; Perminator 10 mil.
 - f. Raven Industries Inc.; Vapor Block 10.
 - g. Reef Industries, Inc.; Griffolyn 10 mil Green.
 - h. Stego Industries, LLC; Stego Wrap 10 mil Class A.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- D. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.5 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch No. 4, No. 8 sieve.
1. Products: Subject to compliance with requirements, available products or equal that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products or equal that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.

- c. ChemMasters; SprayFilm.
- d. Conspec by Dayton Superior; Aquafilm.
- e. Dayton Superior Corporation; Sure Film (J-74).
- f. Edoco by Dayton Superior; BurkeFilm.
- g. Euclid Chemical Company (The), an RPM company; Eucobar.
- h. Kaufman Products, Inc.; Vapor-Aid.
- i. Lambert Corporation; LAMBCO Skin.
- j. L&M Construction Chemicals, Inc.; E-CON.
- k. Meadows, W. R., Inc.; EVAPRE.
- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group; MONOFILM.
- n. Sika Corporation; SikaFilm.
- o. SpecChem, LLC; Spec Film.
- p. Symons by Dayton Superior; Finishing Aid.
- q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
- r. Unitex; PRO-FILM.
- s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Water: Potable.

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

- 1. Products: Subject to compliance with requirements, available products or equal that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
 - b. ChemMasters; Spray-Cure & Seal Plus.
 - c. Conspec by Dayton Superior; Sealcure 1315.
 - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - e. Edoco by Dayton Superior; Cureseal 1315.
 - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
 - g. Kaufman Products, Inc.; Sure Cure 25.
 - h. Lambert Corporation; UV Super Seal.
 - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - j. Meadows, W. R., Inc.; CS-309/30.
 - k. Metalcrete Industries; Seal N Kure 30.
 - l. Right Pointe; Right Sheen 30.
 - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
- 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.8 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.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 20 percent
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: Refer to drawings.
 - 2. Maximum Water-Cementitious Materials Ratio: Refer to drawings.
 - 3. Slump Limit: Refer to drawings.
 - 4. Air Content: Refer to drawings.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with granular fill, fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 - 1. Place and compact a 1/2-inch-thick layer of fine-graded granular material over granular fill.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- 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 tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness as follows:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.4 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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. 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.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- F. 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 (4.4 deg C) 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.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

3.5 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.6 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.7 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 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and

during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by the Architect. Remove and replace concrete that cannot be repaired and patched to the Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square

cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- D. Perform structural repairs of concrete, subject to the Architect's approval, using epoxy adhesive and patching mortar.
- E. Repair materials and installation not specified above may be used, subject to the Architect's approval.

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel reinforcement placement.
- D. 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) 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 (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens:
 - a. Field cure standard cylinder specimens as follows:
 - 1) 1 cylinder at 7 days.
 - 2) 3 cylinders at 28 days
 - 3) 1 cylinder at 56 days.
 8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of one field-cured specimens at 7 days, one set of two specimens at 28 days and one set of field-cured specimens at 56 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. 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 (3.4 MPa).
 11. Test results shall be reported in writing to Architect, the Structural Engineer, 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.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Architect but will not be used as sole basis for approval or rejection of concrete.
 13. 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 the 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 the Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

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SECTION 042200

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Steel reinforcing bars.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.
- B. 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.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

- B. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 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.
- 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.

2.2 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.
- B. Integral Water Repellent: Provide units made with integral water repellent where 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. ACM Chemistries.
 - b. BASF Corporation; Construction Systems.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated.
2. Density Classification: As indicated.

2.3 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.4 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.
- 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.
- D. Masonry Cement: ASTM C 91/C 91M.
 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. Cemex S.A.B. de C.V.
 - b. Essroc.
 - c. Holcim (US) Inc.
 - d. Lafarge North America Inc.
 - e. Lehigh Hanson; HeidelbergCement Group.
- E. Aggregate for Mortar: ASTM C 144.
 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C 404.
- G. 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; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
 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. ACM Chemistries.
 - b. BASF Corporation - Admixture Systems.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
- I. Water: Potable.

2.5 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.
 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. Dur-O-Wal; a Hohmann & Barnard company.
 - b. Heckmann Building Products, Inc.
 - c. Hohmann & Barnard, Inc.
 - d. Wire-Bond.
- 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: 0.148-inch diameter.
 4. Wire Size for Cross Rods: 0.148-inch diameter.
 5. Spacing of Cross Rods: Not more than 16 inches o.c.
 6. Provide in lengths of not less than 10 feet with prefabricated corner and tee units.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 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.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized-steel wire.
- 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.
- D. Partition Top anchors: 0.105-inch- thick metal plate with 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.

2.7 MASONRY-CELL FILL

- A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

2.8 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 or masonry cement mortar unless otherwise indicated.

3. For exterior masonry, use portland cement-lime or masonry cement mortar.
 4. For reinforced masonry, use portland cement-lime or masonry cement 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 S, Type N.
 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- 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, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 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 INSTALLATION, GENERAL

- A. 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.

3.2 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.

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 head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 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. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. 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.

- F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow 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.
- B. Lay solid CMUs 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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 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.

3.6 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.

3.7 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 as indicated.

3.8 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor will engage special inspectors to perform required tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections.
- B. Inspections: Special inspections according to "International Building Code."
 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. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at seven days and at 28 days.

3.9 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.10 MASONRY WASTE DISPOSAL

- A. 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. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. 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 042200

SECTION 054000

COLD-FORMED METAL FRAMING

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. Load-bearing wall framing.
- 2. Soffit framing.

B. Related Requirements:

- 1. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
- 2. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

- 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
- 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Welding certificates.

- C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. 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."
- D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkWestern Building Systems, Inc.
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Craco Mfg., Inc.
 - 6. Custom Stud Inc.
 - 7. Design Shapes in Steel.
 - 8. Dietrich Metal Framing; a Worthington Industries Company.

9. Formetal Co. Inc. (The).
10. MarinoWARE.
11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: As indicated.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 239 Pa (5 lbf/sq. ft.).
 - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 67 deg C (120 deg F).
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1/2 inch.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by drawings.
2. Coating: G60 (Z180).

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by drawings.
2. Coating: G60 (Z180)

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Refer to drawings.
2. Flange Width: Refer to drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/2 inches.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Refer to drawings.
2. Flange Width: Refer to drawings.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Refer to drawings.
 - 2. Flange Width: Refer to drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries company.
 - d. MarinoWARE.
 - e. SCAFCO Corporation.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: Refer to drawings.
 - 2. Flange Width: Refer to drawings.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: Refer to drawings.
 - b. Flange Width: Refer to drawings.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: Refer to drawings.

b. Flange Width: Refer to drawings.

- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: Refer to drawings.
 2. Flange Width: Refer to drawings.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

- D. 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.

- E. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Shims: Load bearing, high-density multi-monomer plastic, and non-leaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

- A. Fabricate cold-formed steel 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.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing 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 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: As shown on Shop Drawings.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: As indicated on drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

- A. Testing: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports, as needed.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Owner and Architect.

- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 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 steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wood furring, grounds, nailers, and blocking.

1.2 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
- B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.
- C. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
 - 1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - 2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.
 - 3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.
- D. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
- E. Warranty of chemical treatment manufacturer for each type of treatment.

- F. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.

- 1. Fire-retardant-treated wood.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
 - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

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. Wood-Preservative-Treated Materials:
 - a. Hickson Corp.
 - b. Hoover Treated Wood Products, Inc.
 - c. Osmose Wood Preserving, Inc.
 - 2. Fire-Retardant-Treated Materials, Interior Type A:
 - a. Hickson Corp.
 - b. Hoover Treated Wood Products, Inc.
 - 3. Fire-Retardant-Treated Materials, Exterior Type:
 - a. American Wood Treaters, Inc.
 - b. Hoover Treated Wood Products, Inc.

2.2 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. SPIB - Southern Pine Inspection Bureau.
 - 2. WWPA - Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.
- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 38-mm actual thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC2 (lumber) and AWPAC9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
 - 1. Do not use chemicals containing chromium or arsenic.
 - 2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPAM4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPAC20 (lumber) and AWPAC27 (plywood). Identify fire-retardant-

treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
 2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
1. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
 2. Contact with treated wood does not promote corrosion of metal fasteners.
- C. Exterior Type: Use for exterior locations and where indicated.
- D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.5 BOARDS

- A. Concealed Boards: Where boards will be concealed by other work, provide lumber with 19 percent maximum moisture content and of following species and grade:
1. Species and Grade: Mixed southern pine, No. 2 per SPIB rules.
 2. Species and Grade: Hem-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 3. Species and Grade: Spruce-pine-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 4. Species and Grade: Western woods, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 5. Species and Grade: Any species above.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.7 PLYWOOD PANELS FOR BACKING

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 12.7 mm thick.
- B. Plywood: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 19 mm thick.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough 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 Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Lag Bolts: ASME B18.2.3.8M.
- E. Bolts: Steel bolts complying with ASTM F 568M, Property Class 4.6; with ASTM A 563M hex nuts and, where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
 - 1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
 - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, Z180 coating designation.

2.10 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to a high-density, polyethylene film to produce an overall thickness of not less than (0.6 mm).
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWP A M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. "Table 1705.1--Fastening Schedule," of the Standard Building Code.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- G. Use hot-dip galvanized or stainless steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 38 mm wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

END OF SECTION 061000

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SECTION 062023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Plastic-laminate cabinets.
 - 3. Wood cabinets.
 - 4. Plastic-laminate countertops.
 - 5. Bullet resistant fiberglass panels.
 - 6. Solid-surface material.
 - 7. Mockup of Judge's bench

1.2 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.

1.3 SUBMITTALS

- A. Product Data: For products and materials indicated, including cabinet hardware and accessories, handrail brackets, and finishing materials and processes, and pass through units.
- 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, pass through units, and other items installed in architectural woodwork.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Shop-applied transparent finishes.
 - 2. Shop-applied opaque finishes.

3. Plastic laminates.
4. Thermoset decorative overlays.
5. Solid-surfacing materials.

D. Samples for Verification: For the following:

1. Lumber with or for transparent finish, 12 sq. in., for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Wood-veneer-faced panel products with or for transparent finish, 12 by 24 in., for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Lumber and panel products with shop-applied opaque finish, 12 sq. in for lumber and 8 by 10 in for panels, for each finish system and color, with 1/2 of exposed surface finished.
5. Plastic-laminate-clad panel products, 8 by 10 in, for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
6. Thermoset decorative-overlay surfaced panel products, 8 by 10 in., for each type, color, pattern, and surface finish.
7. Exposed cabinet hardware and accessories, one unit for each type and finish.
8. Solid-surfacing materials.

E. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork with sequence-matched wood veneers including wood doors where veneer matching includes door faces.

- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards", 7th Edition Version 1.2, 1999 for grades of interior architectural woodwork, construction, finishes, and other requirements.
- E. Mockup of Judge's bench: Construct a mockup of the Judge's bench. The mockup shall be full size and may include the actual floor framing material for final product and may remain. The mockup is to be built as depicted in the details for this area in terms of heights and wall thicknesses. See details (2/A4.01, 3/A4.01, 4/A4.01 and 5/A4.01) and (1/A8.50 2/A8.50 and 5/A8.50). The mockup is not required to have reveals. The walls and counters shall be framed and the exterior finish made of cardboard. The judges will visit the mockup to verify visual sight lines and make adjustments to the heights as necessary to any of the pieces depicted in these details. The monitor tray may be adjusted to desired angle requested by judge. The dimensions for the final product may vary slightly by as much as 4". Shop drawings are to be produced after adjustments are made as requested by the judge. The mock up is to be constructed in the new courtroom area and in the locations as shown on the plans. After the mockup has been approved it shall be removed.
- F. Mockups: Before fabricating and installing interior architectural woodwork, build the following to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockup to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Complete a 10-foot section of the wall and an example area of built-ins to include Jury Box and Bench as mutually agreed upon between the Architect and the Contractor.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be fabricated and installed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting interior architectural woodwork fabrication.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed.
 - 7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Conduct conference at Project site.

1.5 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.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Refer to the Finish Schedule.
- C. Wood Products:
 - 1. Hardboard: AHA A135.4.
 - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 4. Hardwood Plywood and Face Veneers: HPVA HP-1.
- D. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Products and Manufacturers: Refer to the Finish Materials Legend.

- F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.

- 1. Products and Manufacturers: Refer to the Finish Materials Legend.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Hinges: Overlay, self-closing, all metal, 175 degree opening, independent screw action. Hinge plate shall be zinc die cast, T-type, full adjustable. Provide number of hinges per door as recommended by the manufacturer based on door dimension.
 - 1. Product and Manufacturer – Basis of Design: 1200 Series as manufactured by Grass America, Inc.
- C. Pulls: Types as indicated on the Drawings.
- D. Standards and Supports Brackets:
 - 1. Product and Manufacturer – Basis of Design: No. 255 Standards and No. 256 Supports Brackets; Knape & Vogt or equal.
- E. Drawer Slides:
 - 1. Deep Drawers: Side mounted, heavy-duty, 150-pound load rating; full extension.
 - a. Product and Manufacture – Basis of Design: Model 3640; Accuride International, Inc.
 - 2. Standard Depth Drawers up to 24-Inches Wide: Side mounted, heavy-duty, 100-pound load rating; full extension.
 - a. Product and Manufacture – Basis of Design: Model 7432; Accuride International, Inc.
- F. Door Locks: BHMA A156.11, E07121.
- G. Grommets for Cable Passage through Countertops: 2" OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
- H. Wire Management: As indicated on the Drawings.
- I. Foot Bar: Type 302 stainless steel tubing, end caps, and brackets; #4 finish.
 - 1. Bar Diameter: As indicated.
 - 2. Brackets: Type and profile as indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- 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. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Premium grade interior woodwork complying with the 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 3/4" Thick or Less: 1/16"
 - 2. Edges of Rails and Similar Members More Than 3/4" Thick: 1/8".
 - 3. Corners of Cabinets and Edges of Solid-Wood Lumber) Members and Rails: 1/16".
- 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 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: Premium.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- E. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- F. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.
- G. Wood Species and Cut: Refer to the Finish Materials Legend.
 1. Provide split species on trim that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

2.6 PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: As indicated.
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 1. Horizontal Surfaces Other Than Tops: HGS.
 2. Vertical Surfaces: VGS.
 3. Edges: HGS.
- E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 2. Drawer Sides and Backs: Solid-hardwood lumber.

3. Drawer Bottoms: Hardwood plywood.

F. Colors, Patterns, and Finishes: Refer to the Finish Materials Legend.

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

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. Grade: Premium.

C. High-Pressure Decorative Laminate Grade: HGS.

D. Colors, Patterns, and Finishes: Refer to the Finish Materials Legend.

E. Core Material: Marine grade plywood.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

B. Grade: Premium.

C. Solid-Surfacing-Material Thickness: As indicated.

D. Colors, Patterns, and Finishes: Refer to the Finish Materials Legend.

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

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.9 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 700.

B. Grade: Premium.

C. Wood Species and Cut: Refer to the Finish Materials Schedule.

2.10 INTERIOR WOOD FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 900.

- B. Grade: Premium.
- C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.
- D. Wood Species and Cut: Refer to the Finish Materials Legend.
- E. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: Test at atmospheric pressure.
 - 2. Fire Rating: 20 minutes.

2.11 BULLET RESISTANT FIBERGLASS PANELS

- A. Description: Bullet-resistant fiberglass panels.
 - 1. Product and Manufacturer – Basis of Design: Armortex Bullet Resistant Fiberglass; Safeguard Security Services, Inc., San Antonio, TX (800) 880-8306
 - a. Ballistic Level: U.S. Department of Justice NIJ Standard 0108.01 Level III requirements for bullet resistant materials.
 - b. Thickness: As required for performance indicated.

2.12 SHOP FINISHING

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
 - 1. 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. Preparations 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.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: Premium.
 - 2. Finish System: Catalyzed polyurethane.
 - 3. Appearance: Match Architect's sample.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- 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. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. 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" in 8'-0".
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- 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. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces from maximum length of lumber available to greatest extent possible. Do not use pieces less than 36" long, except where shorter single-length pieces are necessary.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - 3. Install standing and running trim with no more variation from a straight line than 1/8" in 8'-0".
- G. 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" in 8'-0" sag, bow, or other variation from a straight line.

2. Maintain veneer sequence matching of cabinets with transparent finish.
 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16" on center.
- H. 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" in 8'-0" sag, bow, or other variation from a straight line.
 3. Secure backsplashes.
 4. Place sealant in space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- I. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 062023

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SECTION 064214

WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood veneer paneling.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

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

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

1. Show details full size.
2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.

C. Samples for Verification: For the following:

1. Wood-veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed paneling similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

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

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of paneling, construction, finishes, and other requirements.

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where paneling 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 paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wood Veneer Paneling: Refer to the Materials Legend.
 1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

- B. VOC Limits for installation Adhesives and Glues: Use installation adhesives that 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. Panel Adhesives: 50 g/L.
 3. Contact Adhesive: 80 g/L.
 4. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.
1. Do not use treated material that does not comply with requirements of referenced woodworking standard or that is warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Comply with performance requirements of AWPA C27 (plywood).
1. Interior Type A: Low-hygroscopic formulation.
 2. Kiln-dry materials before and after treatment to levels required for untreated materials.

2.3 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- 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.

2.4 FABRICATION, GENERAL

- A. Paneling Grade: Provide AWI Premium grade paneling.
- B. Wood Moisture Content: Comply with requirements of the referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

- C. Layout: Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
 - 1. Lay out one elevation at a time if approved by Architect.
 - 2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
 - 3. Provide lighting of similar type and level as that of final installation for viewing layout, unless otherwise approved by Architect.
 - 4. Rearrange paneling as directed by Architect until layout is approved.
 - 5. Do not trim end units and other nonmodular size units to less than modular size until after Architect's approval of layout.
 - 6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- D. Cut openings 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.

2.5 FLUSH WOOD PANELING FOR TRANSPARENT FINISH

- A. Wood Species and Finish: Refer to the Finish Materials Legend.
- B. Panel Core Construction: Fire-retardant plywood.
- C. Fire-Retardant-Treated Paneling: Provide panels consisting of wood-veneer and fire-retardant plywood. Panels shall have a flame-spread rating of 25 or less and a smoke-developed rating of 450 or less per ASTM E 84.
 - 1. Fire Rating Classification: Class 1 (Class A).

2.6 FINISHING

- A. Quality Standard: Comply with AWI Section 1500.
- B. Finish: Refer to the Finish Materials Legend.
 - 1. Finish paneling at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition paneling to average prevailing humidity conditions in installation areas before installation.

3.2 INSTALLATION

- A. Quality Standard: Install paneling to comply with AWI Section 1700.
- B. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8" in 8'-0". Install with no more than 1/16" in 8'-0" vertical cup or bow and 1/8" in 8'-0" horizontal variation from a true plane.
- C. Scribe and cut paneling to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor paneling to supporting substrate with concealed panel-hanger clips and blind nailing. Do not use face fastening unless covered by trim.
- E. Complete the finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces.

END OF SECTION 064214

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SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation.
2. Mineral-wool blanket insulation.
3. Vapor retarders.

B. Related Sections:

1. Division 9 Section 092900 "Gypsum Wall Board".
2. Division 9 Section 092216 "Non-Structural Steel Framing".

1.2 SUBMITTALS

- A. Product Data:** For each type of product indicated.
- B. Product test reports.**
- C. Research/evaluation reports.**

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- 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 at interior partitions as noted on partition types for acoustics:
1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Knauf Insulation.
 5. 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.

2.2 MINERAL-WOOL BLANKET INSULATION

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 at interior fire rated partitions as noted on the partition types:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.

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.

2.3 VAPOR RETARDERS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturer for sealing joints and penetrations at the rigid board insulation.

PART 3 - EXECUTION

3.1 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.

3.2 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. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using one of the following materials:
 - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.3 INSTALLATION OF VAPOR RETARDERS

- A. Seal vertical joints in vapor retarders integral with the rigid board insulation.
- B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- C. Repair tears or punctures in vapor retarders immediately before concealment by other work.

END OF SECTION 072100

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SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 SUBMITTALS

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

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

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

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

D. Product test reports.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

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

1. Penetration firestopping tests are performed by UL.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

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. NUCO Inc.
 4. RectorSeal Corporation.
 5. Specified Technologies Inc.
 6. 3M Fire Protection Products.
 7. Tremco, Inc.; Tremco Fire Protection Systems Group.
 8. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 2. 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. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- F. VOC Content: Provide penetration firestopping that complies 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 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.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) 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.

3.3 FIELD QUALITY CONTROL

- A. Owner may engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.
- D. Any penetration damaged during construction prior to substantial completion shall be removed and repaired to the original condition.

END OF SECTION 078413

SECTION 078443

JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

1.2 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.

C. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

D. Product test reports.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by UL.

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: Ratings determined per ASTM E 1966 or UL 2079:
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
 - d. RectorSeal Corporation.
 - e. Specified Technologies Inc.
 - f. 3M Fire Protection Products.
 - g. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - h. USG Corporation.
- C. Joints in Smoke Barriers: Ratings determined per UL 2079.
 - 1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
 - d. RectorSeal Corporation.
 - e. Specified Technologies Inc.
 - f. 3M Fire Protection Products.
 - g. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - h. USG Corporation.
- D. 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.

- E. VOC Content: Provide fire-resistive joint systems that 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.
- F. 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.
- G. The following are Fire-Resistive Joints that may be required on the project. Refer to the drawings for additional information.
 - 1. Floor to Floor
 - 2. Wall to Wall
 - 3. Head of Wall for a fire-resistive wall assembly
 - 4. Bottom of Wall for a fire-resistive wall assembly
 - 5. Floor to Wall

PART 3 - EXECUTION

3.1 INSTALLATION

- 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. Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. 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.
- D. 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.

3.2 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) 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.

3.3 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner may 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.
- D. Any Fire-Resistive Joint damaged during construction prior to substantial completion shall be removed and repaired to the original condition.

END OF SECTION 078443

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers eight samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.
- D. Product test reports.
- E. Preconstruction compatibility and adhesion test reports.
- F. Field-adhesion test reports: Provide Contractor and Architect a copy of field reports from the manufacturer with 7 calendar days of their site visit and field tests performed.
- G. Warranties.

- H. Provide a mock-up of each exterior wall joints. Mock up may be apart of the completed work if acceptable.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- B. Conduct pre-installation meeting with Contractor, Architect, sheet metal field superintendent, sheet metal project manager, and building envelope consultant attending to review field applications and fabrications.

1.5 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Four years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Four years from date of Substantial Completion.
 - 2. Suggest obtain manufacturer's 20-year warranty.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 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.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have

undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. Pecora Corporation.
 - e. Polymeric Systems, Inc.
 - f. Sika Corporation; Construction Products Division.
 - g. Tremco Incorporated.
2. Type: Single component (S).
3. Grade: nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Nontraffic (NT).

2.3 URETHANE JOINT SEALANTS

- A. Urethane Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. Pacific Polymers International, Inc.
 - d. Pecora Corporation.
 - e. Polymeric Systems, Inc.
 - f. Sika Corporation; Construction Products Division.
 - g. Tremco Incorporated.
2. Type: Single component (S) or multicomponent (M)].
3. Grade: nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Traffic (T).

2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. USG Corporation.

2.6 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) at exterior locations, Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Provide Contractor and Architect written copy of field adhesion testing results within 7 calendar days of test performance.
- D. If the Contractor fails to correct faulty workmanship, to remove and replace defective materials, is negligent or fails to maintain the agreed upon project schedule, and if the Architect or Owner's representative determines the services of the building envelope consultant are made necessary by the Contractor's failure to comply with the specifications and the Contract, building envelope consultant may be hired to observe

the work in progress, to make remedial or replacement recommendations, or to make recommendations for achieving a realistic completion schedule. Associated costs will be the responsibility of the Contractor.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces

1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precast architectural concrete paving units.
 - d. Joints in stone paving units, including steps.
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - g. Other joints as indicated.
2. Joint Sealant: Urethane.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in exterior insulation and finish systems.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - f. Control and expansion joints in ceilings and other overhead surfaces.
 - g. Other joints as indicated.
 - h. All exterior wall penetrations and fixtures; i.e., louvers, lights, pipes, conduits, etc.
2. Joint Sealant: Structural Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
4. These joints in walls and around door frames maybe painted to match adjoining surfaces. Reference drawings for additional information.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in stone flooring.
 - c. Control and expansion joints in tile flooring.

- d. Other joints as indicated.
 - 2. Joint Sealant: Urethane.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and millwork.
 - f. Other joints as indicated.
 - 2. Joint Sealant: Latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Silicone.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Location:
 - a. Acoustical joints where required at acoustical partitions.
 - 2. Joint Sealant: Acoustical.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

SECTION 081113

HOLLOW 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:

- 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

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

1.4 COORDINATION

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

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

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

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection rating and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: SDI A250.8, Level 1.
 - 1. Physical Performance: Level C according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.032 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - 3. Frames:
 - a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.
- C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At stair wells.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.

- c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
- d. Edge Construction: Model 2, Seamless.
- e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

- a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
- b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 BORROWED LITES

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Full profile welded.

2.5 FRAME ANCHORS

A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch- thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

- 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

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

- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch thick, cold-rolled steel sheet set into 0.032-inch thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 081416

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 hardboard or MDF faces.
 - 2. Hollow-core doors with hardboard faces.
 - 3. Shop priming flush wood doors.
 - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Division 8 Section "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, louvers, 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; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.
- 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 finished Work.
2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
3. 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.
4. Louver blade and frame sections, 6 inches long, for each material and finish specified.
5. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body and is a certified participant in AWI's Quality Certification Program.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD 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 remainder of construction period.

1.9 WARRANTY

- A. A. Special Warranty: 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.
4. Warranty Period for Hollow-Core Interior Doors: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Algoma Hardwoods, Inc.
 2. Graham Wood Doors; an Assa Abloy Group company.
 3. Lambton Doors.
 4. Marshfield Door Systems, Inc.
 5. Mohawk Doors; a Masonite company.
 6. Oshkosh Door Company.
 7. VT Industries, Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

- B. Certified Wood: Flush wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- C. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- D. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. WDMA I.S.1-A Performance Grade:
 - 1. Extra Heavy Duty: All doors unless otherwise indicated.
 - 2. Standard Duty: All doors within the apartments on floors two through nine and the ground floor staff/guest apartments
- F. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- G. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- H. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch top-rail blocking, in doors indicated to have closers.
 - b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.

- c. 5-inch midrail blocking, in doors indicated to have exit devices.
 - 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- I. Structural-Composite-Lumber-Core Doors:
- 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- J. Mineral-Core Doors:
- 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:
 - a. 5-inch top-rail blocking.
 - b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch midrail blocking, in doors indicated to have armor plates.
 - d. 4-1/2-by-10-inch lock blocks or 5-inch midrail blocking, in doors indicated to have exit devices.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.
- K. Hollow-Core Doors:
- 1. Construction: Commercial hollow core.
 - 2. Blocking: Provide wood blocking with minimum dimensions as follows:
 - a. 5-by-18-inch lock blocks at both stiles.
 - b. 5-inch top-and bottom-rail blocking.
 - c. 2-1/2-inch midrail blocking.

2.3 DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

- 1. Grade: Premium
- 2. Faces: HDF – High Density Fiber
- 3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
- 4. Core: Either glued wood stave or structural composite lumber

5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
6. WDMA I.S.1-A Performance Grade: As indicated.
7. Factory primed for field applied finish coats

B. Interior Hollow-Core Doors:

1. Grade: Premium
2. Faces: HDF – High Density Fiber
3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
4. WDMA I.S.1-A Performance Grade: As indicated.
5. Factory primed for field applied finish coats

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Any closed-grain hardwood.
 2. Profile: Flush rectangular beads
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

- C. Openings: Factory cut and trim openings through doors.
 - 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."
 - 3. Louvers: Factory install louvers in prepared openings.

2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099000 "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed 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 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or 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 083220

STEEL DETENTION DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. This Section includes detention security hollow metal [bullet resistant] products as scheduled in the contract drawings and as specified herein.

1.2 PRODUCTS PROVIDED UNDER THIS SECTION

- A. Detention security hollow metal doors with specified ½-hour fire rating and Level III bullet resistance rating as indicated in the door schedule. Doors shall be swinging type and shall be provided in the types and sizes scheduled in the contract drawings and as specified herein.
- B. Detention security hollow metal frames with specified fire rating and bullet resistance rating as indicated in the door schedule. Frames shall be provided in the types and sizes scheduled in the contract drawings and as specified herein.
- C. Detention security hollow metal frame infill panels with specified security grade, fire rating and/or bullet resistance rating as indicated in the door schedule. Panels shall be provided in the types and sizes scheduled in the contract drawings and as specified herein.

1.3 RELATED SECTIONS

- A. Section 087810 Detention Door Hardware
- B. Section 088000 Glazing
- C. Section 033000 Cast-in-Place Concrete
- D. Section 042000 Concrete Unit Masonry
- E. Section 024119 Selective Demolition

1.4 REFERENCES

- A. ASTM A 1008 / A 1008M-16, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

- B. ASTM A 1011 / A 1011M-15, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- C. ASTM A 653/A 653M-15e1, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dipped Process, (Commercial Steel)
- D. ASTM A 666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
- E. ASTM C 143 / C 143M-15a, Standard Test Method for Slump of Hydraulic Cement Concrete
- F. ANSI A 250.10 – 2011, Standard Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
- G. ASTM F 1450-12a (2004), Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention and Correctional Facilities
- H. ASTM F 1592-12, Standard Test Methods for Detention Hollow Metal Vision Systems
- I. ANSI / NAAMM HMMA 801-12, Glossary of Terms for Hollow Metal Doors and Frames
- J. NAAMM HMMA 803-08, Steel Tables
- K. NAAMM HMMA 820-08, Hollow Metal Frames
- L. HMMA-820 TN01-03, Grouting Hollow Metal Frames
- M. NAAMM HMMA 840-07, Installation and Storage of Hollow Metal Doors and Frames
- N. NAAMM HMMA 850-00, Fire-Rated Hollow Metal Doors and Frames, Second Edition
- O. ANSI / NAAMM HMMA 866-12, Guide Specifications for Stainless Steel Hollow Metal Doors and Frames
- P. ANSI / NFPA 80-2016, Fire Doors and Windows
- Q. ANSI / NFPA 105-2016, Recommended Practice for the Installation of Smoke Control Door Assemblies
- R. ANSI / NFPA 252-2017, Standard Methods of Fire Tests of Door Assemblies
- S. ANSI / NFPA 257-2017, Methods for Fire Test of Window Assemblies
- T. ANSI / UL 9-2009, Fire Test of Window Assemblies, 7th Edition
- U. ANSI / UL 10B-2008, Fire Test of Door Assemblies, 9th Edition
- V. ANSI / UL 10C-2016, Standard for Positive Pressure Fire Tests of Door Assemblies, 1st Edition

- W. UL 1784-2015, Air Leakage Tests of Door Assemblies, 3rd Edition
- X. UL 752-05, 11th Edition, Bullet Resisting Equipment

ANSI	American National Standards Institute, Inc. 25 W. 43 rd Street New York, NY 10036 Telephone: 212-642-4900 www.ansi.org
ASTM	American Society for Testing and Materials <i>Also known as ASTM International</i> 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 Telephone: 610-832-9585 www.astm.org
ICBO	International Code Council – Los Angeles Office <i>Formerly known as International Conference of Building Officials</i> Uniform Building Code 5360 Workman Mill Road Whittier, California 90601-2298 Telephone: 592-692-4226 www.icbo.org
NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Avenue Suite 1000 Chicago, IL 60603 www.naamm.org
NFPA	National Fire Protection Association 1 Batterymarch Park P.O. Box 9101 Quincy, MA 02269 Telephone: 617-770-3000 www.nfpa.org
UL	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, Illinois 60062 Telephone: 708-272-8800 www.ul.com

1.5 TESTING AND PERFORMANCE

Performance grades for each opening shall be as indicated on the contract documents. Performance test requirements for each opening shall be as indicated for individual grade number designations shown in the tables in ASTM F 1450 and ASTM F 1592. Test procedures shall be performed on door and frame designs as described in Sections A, B, C, D and E.

A. Door Assembly Impact Test

1. Two 3 ft. x 7 ft. (914 mm x 2134 mm) doors of each Grade to be tested shall be constructed in accordance with Section 2.01, each with 100 square inch (645.2 cm²) vision panel, 4 in. x 25 in. (102 mm x 635 mm) clear opening positioned generally as shown in ASTM F 1450, Figure 1. Doors shall have a maximum weight for Grades 1 and 2 of 230 lbs. and for grades 3 and 4 of 190 lbs. Two accompanying frames shall be constructed in accordance with Section 2.03. One door and frame assembly shall be equipped with hardware in accordance with ASTM F 1450, Paragraph 6.1.2.4. The other assembly shall be equipped with hardware in accordance with ASTM F 1450, Paragraph 6.1.2.5. Test doors and frames shall be installed and tested in accordance with ASTM F 1450, Section 6, "Specimen Preparation" and Section 7.2 "Door Assembly Impact Test." The test assemblies shall meet the acceptance criteria in Section 7.2 in order to qualify under Section 1.05 of this specification.
2. Two 3 ft. x 7 ft. (914 mm x 2134 mm) doors of each Grade to be tested shall be constructed in accordance with Section 2.01 of this specification, each with two vision lights centered horizontally and located generally as shown in ASTM F 1450, Figure 1. The top vision shall a clear opening size of 19 in. x 28 in. (483 mm x 711 mm) with impact panel installed. The bottom vision shall have a clear opening size of 19 in. x 18 in. (483 mm x 457 mm) with impact panel installed. Doors shall have a maximum weight for Grades 1 and 2 of 230 lbs. and for grades 3 and 4 of 190 lbs. Two accompanying frames shall be constructed in accordance with Section 2.03 of this specification. One door and frame assembly shall be equipped with hardware in accordance with ASTM F 1450, Paragraph 6.1.3.4. The other assembly shall be equipped with hardware in accordance with ASTM F 1450, Paragraph 6.1.3.5. Test doors and frames shall be installed and tested in accordance with ASTM F 1450, Section 6, "Specimen Preparation" and Section 7.2 "Door Assembly Impact Test." The test assemblies shall meet the acceptance criteria in Section 7.2 in order to qualify under Section 1.05 of this specification.

B. Detention Hollow Metal Vision System Impact Test In Accordance With ASTM F 1592

1. A four (4) equal light multi-light security hollow metal assembly, overall dimensions of 48 in. width x 48 in. height (1219 x 1219 mm), shall be constructed in accordance with this specification, Section 2.03, and shall be impact tested in accordance with ASTM F 1592, Sections 5, 6 and 7.2. The test assembly shall meet the acceptance criteria in Section 7.2 in order to qualify under Section 1.05 of this specification.
2. A single sidelight security hollow metal assembly, door dimensions 3 ft. x 7 ft. (914 mm x 2134 mm) and sidelight dimensions with clear opening size of 30 in. wide x 42 in. high +/- 1 in. (762 mm x 1066 mm +/- 25 mm), shall be constructed in accordance with Sections 2.01 and 2.03, and shall be impact tested in accordance with ASTM F 1592, Sections 5, 6 and 7.2. The test assembly shall meet the acceptance criteria in Section 7.2 in order to qualify under Section 1.05 of this specification.

C. Door Static Load Test

Two (2) doors of each Grade to be tested constructed identically to each of the test doors required for Section 1.05.A.1 "Door Assembly Impact Test," 3 ft. x 7 ft. (914 x

2134 mm), with 4 in. x 25 in. (102 mm x 635 mm) vision panel, and with hardware preparations, shall be tested in accordance with ASTM F 1450, Section 7.3, "Door Static Load Test." The test doors shall meet the acceptance criteria in Section 7.3 in order to qualify under Section 1.05 of this specification.

D. Door Rack Test

Two (2) doors constructed identically to each of the test doors required in Section 1.05.A, "Door Assembly Impact Test," 3 ft. x 7 ft. (914 mm x 2134 mm), with 4 in. x 25 in. (102 mm x 635 mm) vision panel, and with hardware preparations shall be tested in accordance with ASTM F 1450, Section 7.4, "Door Rack Test." The test doors shall meet the acceptance criteria in Section 7.4 in order to qualify under Section 1.05 of this specification.

One 12 gauge door, .093 in. (2.3 mm), with two large vision lights as shown in ASTM F1450, Figure 2, with an "edge cut" food pass/cuff port 5 in. (127 mm) x 14.25 in. (362 mm) located 36.5 from the bottom of the door to the center line of the opening as shown in ASTM F1450, Figure 3, shall be constructed in accordance with Section 2.01 of this specification. The door shall be tested in accordance with ASTM F 1450, Section 7.4, "Door Rack Test". The test door shall meet the acceptance criteria in Section 7.4.4.11 in order to qualify under Section 1.05 of this specification.

E. Door Edge Crush Test

One (1) door constructed identically to any of the test doors required in Section 1.05.A, "Door Assembly Impact Test," with hardware preparations, shall be tested in accordance with ASTM F 1450, Section 7.7 "Door Edge Crush Test."

F. Bullet Resistance Test

1. Where specified for individual openings, bullet resistance shall be certified by the application of a laboratory bullet resistance rating label on the door covering the assembly opening indicating compliance with the testing procedure described in UL Standard 752, and consistent with ASTM F 1450, Section 6, "Specimen Preparation" and Section 7.1, "Bullet Penetration." The bullet resistance rating shall be Level 3.

G. Test Reports

The manufacturer shall provide test reports and documentation by an independent testing laboratory in accordance with the reporting requirements of ASTM F 1450 and ASTM F 1592 certifying compliance with ANSI/NAAMM/HMMA 863, Section 1.05., current within five (5) years.

H. Labeled Fire Rated Doors and Frames

1. Fire labeled doors, frames, transom frames and side light assemblies shall be provided for those openings requiring fire protection, temperature rise, or smoke and draft control ratings as determined and scheduled by the Architect. Such products shall be tested in accordance with [ANSI/NFPA-252 or ANSI/UL-10B] [ANSI/UL-10C or UBC 7-2; Part 1] [UL 1784 or UBC 7-2; Part 2 or ANSI/NFPA 105] and

- constructed as listed and/or classified by a recognized testing agency having a factory inspection service.
2. Window frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect. Such frames shall be tested in accordance with [ANSI/NFPA 257 or ANSI/UL 9] [UBC 7-4] and constructed as listed for labeling by a recognized testing laboratory having a factory follow up inspection service.
 3. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason, the Architect shall be so advised in the submittal documents or prior to manufacture of the product.

1.6 QUALITY ASSURANCE

A. Acceptable Manufacturers

1. Trussbilt, LLC – Vadnais Heights, MN
Telephone: 651-633-6100 Fax: 651-628-9482
Website: www.trussbilt.com
2. American Steel Products
Telephone: 706-413-3816
Website: www.amsteelpro.com
3. APEX Industries
Telephone: 80-268-3331
Website: www.apexindustries.com
4. Other manufacturers must submit their qualifications, test reports and product deviations to the architect ten (10) days prior to the bid for approval. Test reports must include name and address of laboratory, date laboratory completed the tests, name and address of manufacturer, description of identifying markings on all components of test assembly, location of testing equipment, diagrams, details and photographs of testing equipment, specifications and details of components of test assembly drawings, door and frame component drawings, hardware templates and instructions, wall specifications, and details of anchoring devices, and all test data and load deflection graphs.

B. Manufacturer's Qualification

1. Manufacturer shall provide evidence of having personnel and plant equipment capable of fabricating hollow metal door and frame assemblies of the type specified herein. Manufacturer shall provide current documentation of the number of employees, a listing of their production equipment, and a description of their manufacturing facility.

Manufacturers shall be ISO 9001:2008 certified and shall be required to present their Certificate of Registration upon request. The manufacturer's registrar shall be nationally recognized and shall provide the manufacturer with periodic factory follow up audits reaffirming the manufacturer's continuing compliance with their written quality program.

2. Manufacturer's production welders shall be qualified under AWS D1.3 and upon request shall provide copies of Welders Certifications in accordance with AWS D1.3.
3. Manufacturers shall have a minimum of ten (10) years experience successfully producing detention hollow metal of the types and sizes required in the contract documents. Upon request the manufacturer shall provide a list of successfully completed projects and the dates they were completed.
4. Manufacturers shall have written test reports of their having passed the testing requirements of section 1.05 and using their current materials and production processes.

C. Samples

1. Door: 1'-0" x 1'-0" (305 mm x 305 mm) corner section with hinge mortise and reinforcement showing internal construction.
2. Frame: 1'-0" x 1'-0" (305 mm x 305 mm) corner section showing welding of head to jamb. Include hinge mortise, reinforcement and plaster guard in one rabbet, and glazing stop applied as specified in the opposite rabbet. Glazing stop shall be applied in both head and jamb section to show corner joint.
3. All samples submitted shall be of the production type and shall represent in all respects the minimum quality of work to be furnished by the manufacturer. No work represented by the samples shall be fabricated until the samples are approved, and any downgrading of quality demonstrated by the samples can be cause for rejection of the work.

D. Quality Criteria

1. All door and frame construction shall be in accordance with construction of assemblies, which meet the testing requirements of Section 1.05.
2. Fire labeled doors and frames shall be provided for those openings indicated in the schedule as requiring fire protection ratings. Such doors and frames shall be constructed as tested in accordance with ASTM E 152, UL-10B or NFPA-252 and labeled by a recognized testing agency having a factory inspection service.
3. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.

4. Fabrication methods and product quality shall meet standards set by the Hollow Metal Manufacturers Association, HMMA, a Division of the National Association of Architectural Metal Manufacturers, NAAMM, as set forth in these specifications.
5. Job Site Door Check
At the owner's option, a door at the job site shall be selected at random and sawed in half or otherwise taken apart as deemed necessary for verification that construction is in accordance with these specifications. If the door construction does not conform to these specifications the non-conforming doors shall be repaired or replaced at the manufacturer's expense. If the door construction complies with the specification a replacement door must be ordered and added to the project, not at the cost of the manufacturer.

1.7 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of detention door and frame specified.
- B. Shop Drawings: For detention doors and frames. Include conditions at openings, details of construction, dimensions of profiles, and details of joints and connections. Show anchorage and accessories. Identify each detention door and frame using same reference numbers for openings as those on Drawings.
- C. Coordination Drawings: Drawings of each opening, including detention door and frame, drawn to scale and coordinating detention door hardware. Show the following:
 1. Locations, dimensions, and profiles of detention door hardware reinforcements.
 2. Locations and installation details of detention door hardware.
 3. Elevations of each detention door design type showing dimensions, locations of detention door hardware, and preparations for power, signal, and electrified control systems.
 4. Details of each detention frame type.
- D. Samples for Verification:
 1. For the following items, prepared on Samples approximately 12" by 12" to demonstrate compliance with requirements for quality of materials and construction:
 - a. Detention Doors: Show vertical-edge, top, and bottom construction; insulation; face stiffeners; and hinge and other applied hardware reinforcement. Include glazing stops if applicable.
 - b. Detention Frames: Show profile, welded corner joint, welded hinge reinforcement, dust-cover boxes, floor and wall anchors, stops, and silencers. Include panel section and glazing stops if applicable.
- E. Oversize Construction Certification: For detention door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing

agency acceptable to authorities having jurisdiction that each detention door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

- F. Qualification Data: For Installer and manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for detention doors and frames.
- H. Other Action Submittals:
 - 1. Schedule: For detention doors and frames, using same reference numbers for details and openings as those indicated on Drawings.
 - a. Indicate performance grades of detention doors.
 - b. Coordinate detention frames and stops with glazing requirements.
- I. Other Informational Submittals:
 - 1. Examination reports documenting inspection of substrates, areas, and conditions.
 - 2. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
 - 3. Field quality-control reports documenting inspections of installed products.
 - 4. Field quality-control certification.

1.8 MAINTENANCE TOOLS

- A. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.

1.9 WARRANTY

- A. All hollow metal work shall be warranted from defects in workmanship and quality for a period of one (1) year from the date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 DETENTION SECURITY HOLLOW METAL DOORS

- A. Materials
 - 1. Doors shall be manufactured of commercial quality, level, hot-rolled, pickled and dry steel conforming to ASTM A 1011 / A 1011M CS type B. The steel shall be free of scale, pitting, coil breaks, buckles, waves or other surface blemishes or defects.

2. Interior doors: Face sheets shall be [for Grades 3 and 4: 0.067 in. (1.7 mm)] [for Grades 1 and 2: 0.093 in. (2.3 mm)] minimum thickness.

B. Construction

1. All doors shall be of the types and sizes shown on the approved submittal drawings, shall be constructed in accordance with the specifications and shall meet the performance requirements of Paragraph 1.05 where applicable. Alternate materials and methods of construction, which meet the aforementioned performance criteria, shall be permitted.
2. Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door. This edge seam weld shall be sanded smooth and be neat in appearance. The door vertical edges shall not be covered with auto body putty or metallic fillers. The weld shall be visible to ensure a continuous weld.
3. Door thickness shall be 2 in. (50 mm) nominal to accommodate detention hardware. Doors shall be neat in appearance and free from warpage or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of material used.
4. The door shall be stiffened by one of the following systems:
 - a. Continuous steel truss design core material, .015 in. (.4 mm) minimum, having truncated triangular roll formed sections extending continuously from one door face to the other, spot welded to each face sheet 2 $\frac{3}{4}$ in. (69.9 mm) oc horizontally and 3 in. (76.2 mm) oc vertically. Core material shall extend full height and width of door.
 - b. Continuous vertical hat sections, one such hat section welded to each face of the door, .053 in. (1.3 mm), with vertical webs no more than 4 in. (101.6 mm) apart. Hat sections shall be welded to each other at 6 in. (152.4 mm) oc both sides in order to prevent separation.

Spaces between stiffeners shall be filled with fiberglass or mineral rockwool batt-type material, minimum 6 lb. density.

5. The vertical edges shall be reinforced by a continuous steel channel extending the full height of the door and welded to both face sheets. The channels' thickness shall be not less than the thickness of the door face sheet. The top and bottom edges shall be closed with a continuous channel, the same thickness as the vertical edge channels and shall be spot-welded to the face sheet a maximum of 3 in. (76 mm) o.c. The closing end channel shall be continuously welded to the vertical reinforcing channel at all four corners producing a fully welded perimeter reinforcing channel.
6. The top and bottom end channel shall be fitted with an additional flush closing channel of the same material thickness. The flush closing channel shall be welded in place at the corners and at the center. Tops of exterior doors shall be made weather tight where specified.

7. Edge profiles shall be provided on both vertical edges of doors as follows:

Single acting doors - beveled 1/8 in. (3 mm) in 2 in. (50 mm) profile
Sliding doors or equivalent - square profile

8. Hardware reinforcements:

- a. Doors shall be mortised, reinforced, drilled and tapped at the factory for completely templated mortised hardware only, in accordance with the final approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware - or non-templated mortised hardware - is to be applied, doors shall be reinforced, and all drilling and tapping shall be done by others in the field.
- b. Minimum thicknesses for hardware reinforcements shall be as follows:
 - Full mortise hinges and pivots 0.167 in. (4.2 mm)
 - Surface applied maximum security hinges 0.214 in. (5.4 mm)
 - Strikes (reinforcing tabs) 0.167 in. (4.2 mm)
 - Strikes (channel reinforcement) 0.125 in. (3.17 mm)
 - Slide device hanger attachment- per device manufacturer's recommendations.
 - Lock fronts, concealed holders, or surface mounted closer 0.093 in. (2.3 mm)
 - All other surface applied hardware 0.093 in. (2.3 mm)
- c. In cases where electrically operated hardware is required, and where shown on approved submittal drawings, hardware enclosures and junction boxes shall be provided and shall be interconnected using UL approved 0.75" (19 mm) minimum diameter conduit and connectors. Also, where shown on submittal drawings, junction boxes with access plates shall be provided to facilitate the proper installation of wiring. Access plates shall be the same thickness as the face sheet and fastened with a minimum of four (4) #8-32 tamper resistant machine screws, not to exceed 6 in. (152 mm) o.c.

9. Glass moldings and stops:

- a. Where specified, doors shall be provided with steel moldings to secure glazing by others in accordance with glass sizes and thicknesses shown on approved submittal drawings.
- b. Fixed glass molding shall be not less than 0.093 in. (2.3 mm), and shall be spot-welded to both face sheets 3.0 in. (76 mm) o.c. maximum.

- c. In glass openings where security glazing is specified and where shown on the approved submittal drawings, pressed steel angle glazing stops (or "Z" or plate type stops depending on glass thickness), no less than 0.093 in. (2.3 mm) thickness, shall be provided. Angle stops shall be mitered or notched and tight fitting at the corner joints, and secured in place using 1/4 - 20 or 1/4 - 28 button head tamper resistant screws with spacing necessary to satisfy the performance criteria outlined in Section 1.05.
 - d. Metal surfaces to which glazing stops are secured, and the inside of the glazing stops shall be treated for maximum paint adhesion and painted with a rust inhibitive primer prior to installation in the door, or shall be fabricated from A60 (ZF180) zinc coated steel per 2.01.A.3.
10. Product Identification: Doors shall have the Architect's mark number permanently stamped on the center hinge reinforcement for swing doors and on the horizontal Z of the window for sliding door types.

2.2 HOLLOW METAL INFILL PANELS

- A. Hollow metal infill panels shall be made of the same materials and construction and finished in the same way as specified in Section 2.01 of this specification.

2.3 HOLLOW METAL INFILL PANELS

A. Materials

- 1. Frames shall be constructed of commercial quality, hot rolled, pickled dry steel conforming to A1011/A1011M. The steel shall be free of scale, pitting, coil breaks or other surface defects.
- 2. Interior openings: Steel shall be 0.093 in. (2.3 mm) minimum thickness.

B. Construction:

- 1. All frames, with the exception of cased openings such as for sliding doors, shall have integral stops and be welded units of the sizes and types shown on approved submittal drawings. Frames shall be constructed in accordance with these specifications and meet performance criteria specified in Section 1.05 where applicable. Alternate materials and methods of construction, which meet the aforementioned performance criteria, shall be permitted.
- 2. All finished work shall be neat in appearance, square, and free of defects, warps and buckles. Pressed steel members shall be straight and of uniform profile throughout their lengths.

3. Jamb, header and sill profiles shall be in accordance with the frame schedule and as shown on the approved submittal drawings.
4. Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered. Corner joints shall be continuously welded and the use of gussets or splice plates shall be unacceptable.
5. Minimum height of stops in door openings shall be 0.75 in. (19 mm). Height of stops on security glass or panel openings shall be as shown on approved submittal drawings.
6. When shipping limitations so dictate, frames for large openings shall be fabricated in sections designated for splicing in the field by others. Where splicing is necessary, angle splices shall be installed at the corners of the profile, and shall extend at least 1 in. (25.4 mm) on either side of the joint. Splicing angles shall be the same gage thickness as the frame. Field splices shall be made in accordance with approved submittal drawings.
7. Frames for multiple openings shall have mullion members which, after fabrication, are closed tubular shapes conforming to profiles shown on approved submittal drawings. All exposed joints between faces of abutted members shall be continuously welded and finished smooth. All exposed joints between stops of abutted members shall be welded along the soffit and shall be left neat and uniform in appearance. At mullions, longitudinal joint may occur creating a seam. Where possible, conceal this seam behind a glazing stop. The contractor responsible for installation shall provide for welding and finishing all field joints between faces of abutted members.
8. Hardware Reinforcements and Preparation:
 - a. Frames shall be mortised, reinforced, drilled and tapped for all templated mortised hardware only, in accordance with the final approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware - anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated mortised hardware - is to be applied, frames shall be reinforced, and all drilling and tapping shall be done by others in the field.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:

• Hinges and pivots	0.167 in. x 1.5 in. x 10 in. length (4.2 mm x 38 mm x 254 mm)
• Strikes	0.167 in. (4.2 mm)
• Closers (concealed)	0.167 in. (4.2 mm)
• Flush bolts	0.167 in. (4.2 mm)
• All other surface applied hardware	0.093 in. (2.3 mm)

- c. In cases where electrically operated hardware is required, and where shown on contract drawings, hardware enclosures and junction boxes shall be provided, and shall be interconnected using UL approved 0.75 in. (19 mm) diameter minimum conduit and connectors. Also, where shown on submittal drawings, junction boxes with access plates shall be provided to facilitate the proper installation of wiring. Access plates shall be the same thickness as the frame and fastened with a minimum of four (4) #8-32 tamper resistant machine screws, not to exceed 6 in. (152 mm) o.c.

9. Floor Anchors:

- a. Floor anchors with two holes for fasteners shall be fastened inside jambs with at least four (4) spot welds, per anchor or MIG welded on both sides.
- b. Where so scheduled, adjustable floor anchors, providing not less than 2 in. (50 mm) height adjustment, shall be fastened in place with at least four (4) spot-welds per anchor or MIG welded on both sides.
- c. Thickness of floor anchors shall be the same as frame.

10. Jamb Anchors:

a. Anchor Spacing

The number of anchors provided on each jamb shall be as follows:

Borrowed lite frames	2 anchors plus 1 for each 24 in. (406 mm) or fraction thereof over 36 in. (914 mm), spaced at 24 in. (406 mm) maximum between anchors
Door frames	2 anchors plus 1 for each 24 in. (406 mm) or fraction thereof over 54 in. (1372 mm), spaced at 24 in. (406 mm) maximum between anchors (fire ratings can require additional anchors)

b. Masonry Type

Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the strap and stirrup type made from the same thickness steel as frame. Straps shall be 2 in. x 10 in. (50 mm x 254 mm) in size, corrugated and perforated.

c. Embedment Masonry Type

- i. Frames for installation in prefinished masonry or concrete openings shall be provided with removable faces at the jambs, and 0.167 in. x 2 in. x 2 in. (4.2 mm x 50 mm x 50 mm) angle anchors 4 in. (102 mm) long spaced as described in Paragraph 2.03.B.10.a. The frame anchors shall be located to

coincide with matching embedded anchors to be provided for installation in the wall.

- ii. Embedded wall anchors shall consist of a 0.167 in. (4.2 mm) x 4 in. (102 mm) wide x 6 in. (152 mm) plate with 0.167 in. x 2 in. x 2 in. (4.2 mm x 50 mm x 50 mm) angle anchors 4 in. (102 mm) long welded in place at locations to match angle anchors in frames. The embedded plate shall be provided with two (2) #4 re-bar wall anchors 10 in. (254 mm) long minimum, with 2 in. (51 mm) x 90 degree turn down on ends continuously welded in place, and spaced as described in Paragraph 2.03.B.10a. Embedments shall be prime painted in accordance with Paragraph 2.03.B.14.
- iii. Angle anchors shall each be fastened to jamb and to embedded plate with two (2) 1 in. (25 mm) long arc welds at each end of the anchor. Anchors shall be shipped loose.
- iv. The complete anchorage system shall provide that the jamb faces be removed from the frames in the field by the contractor responsible for installation, and the frames be moved into the opening until the frame anchors contact and match the embedded anchors. The contractor responsible for installation shall field weld all anchors and install the jamb faces in place. Embedment anchoring details shall be provided on approved submittal drawings.

d. Expansion Bolt Type

- i. Frames for installation in existing masonry or concrete walls shall be prepared for expansion bolt type anchors. The preparation shall consist of a punch and dimpled hole for a 0.5 in. (13 mm) diameter bolt and a .093 in. (2.3 mm) spacer from the unexposed surface of the frame to the wall. The spacer shall be welded to the frame and the preparation spaced as described in Paragraph 2.03.B.10.a.
 - ii. After sufficient tightening of the bolt, the bolt head shall be welded by the installation contractor so as to provide a non-removable condition. The welded bolt head shall be ground, dressed and finished smooth.
- e. Frames to be installed in pre-finished concrete, masonry or steel openings shall be constructed and provided with anchoring systems of suitable design as shown on the approved submittal drawings.

11. Grout guards shall be provided at all hardware preparations, glazing stop screws and silencer preparations on frames to be set in masonry or concrete openings. Grout guards shall be sufficient to protect preparations from grout of a 4 in. (102 mm) maximum slump consistency which is hand troweled in place. All hinge grout guards and lock pockets shall be caulked after priming to ensure maximum protection from grout seepage.

- a. Grout guards for glazing stop screws shall be factory installed and shall cover the exposed portion of the screws inside the frame throat, around the perimeter.

Where mullions are required to be grouted, screws inside mullions shall be protected with grout guards.

- b. Steel grout guards shall protect silencer preparations where accessible from the frame throat. Silencers shall be furnished and installed by the contractor responsible for frame installation except where limited access prevents installation of the metal grout guards in mullions, in which case silencers shall be factory furnished and installed.
12. All frames shall be provided with two (2) temporary steel spreaders welded to the bottom of the jambs to serve as bracing during shipping and handling. The installation contractor shall be responsible for removing, finishing, and touch-up of marks caused by spreader removal.

13. Removable glazing stops:

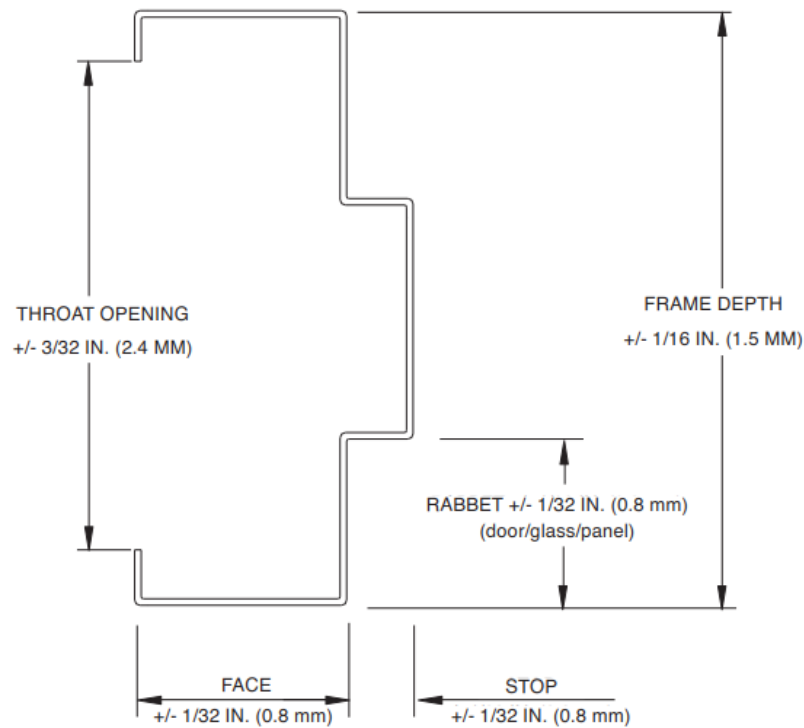
- a. In openings where security glazing is specified and where shown on the approved submittal drawings, pressed steel angle glazing stops, not less than 0.093 in. (2.3 mm), shall be provided. Angle stops shall be mitered or notched and tight fitting at the corner joints, and secured in place using 1/4 - 20 or 1/4 - 28 button head tamper resistant screws with spacing necessary to satisfy the performance criteria outlined in Section 1.05.
- b. The frame underneath the glazing stops and the inside of the glazing stops shall be treated for maximum paint adhesion and painted with a rust inhibitive primer prior to installation in the frame.

2.4 MANUFACTURING TOLERANCES

A. Manufacturing tolerance shall be maintained within the following limits:

- 1. Frames for single doors or pairs of doors:
 - a. Width, measured between rabbets at the head: Nominal opening width + 1/16 in. (1.6 mm), - 1/32 in. (0.8 mm).
 - b. Height (total length of jamb rabbet): Nominal opening height +/- 3/64 in. (1.2 mm).
- 2. Cross sectional profile dimensions (see Figure 1):
 - a. Face +/- 1/32 in. (0.8 mm)
 - b. Stop +/- 1/32 in. (0.8 mm)
 - c. Rabbet +/- 1/32 in. (0.8 mm)
 - d. Depth +/- 1/32 in. (0.8 mm)
 - e. Throat +/- 1/32 in. (0.8 mm)

Note: Frames overlapping walls to have throat dimension 1/8 in. (3.1 mm) greater than wall thickness to accommodate irregularities in wall construction.

**Figure 1**

3. Flatness of large frames 1/8 in. (3.1 mm) in 10 ft. (3048 mm) of length or width.
4. Doors – Doors are undersized to fit the frame. Edge clearances are based upon individual door manufacturer's designs. Tolerance on actual door sizes are as follows:
 - a. Width +/- 3/64 in. (1.2 mm)
 - b. Height +/- 3/64 in. (1.2 mm)
 - c. Thickness +/- 1/16 in. (1.5 mm)
 - d. Bow / flatness +/- 1/8 in. (3.2 mm) in 7 ft. (2134 mm)
5. Hardware
 - a. Cutout and template dimensions +/- 0.015 in. (0.38 mm) - 0 in.
 - b. Location +/- 1/32 in. (0.8 mm)
 - c. Between hinge centerlines +/- 1/64 in. (0.4 mm)

2.5 HARDWARE LOCATIONS

The location of hardware on doors and frames shall be as listed below. Note that all dimensions except the hinge locations are referenced from the finished floor as defined in Section 3.03.

- A. Hinges:
 - Top 5 in. (177.8 mm) from frame head to top of hinge
 - Bottom 10 in. (254 mm) from floor to bottom of hinge
 - Intermediate centered between top and bottom hinges
- B. Locks and latches 38 in. (965 mm) to centerline of knob or lever shaft
- C. Deadlocks 37 in. (1168 mm) to centerline of bolt
- D. Exit Hardware 38 in. (965 mm) to centerline of cross bar or as shown
on hardware template
- E. Door Pulls 47 in. (1066 mm) to centerline of grip
- F. Push Plates 47 in. (1168 mm) to centerline of plate
- G. Intercoms 48 in. (1219 mm) to centerline of intercom / backbox

Note: All dimensions are subject to change depending on hardware items having to move to avoid interference.

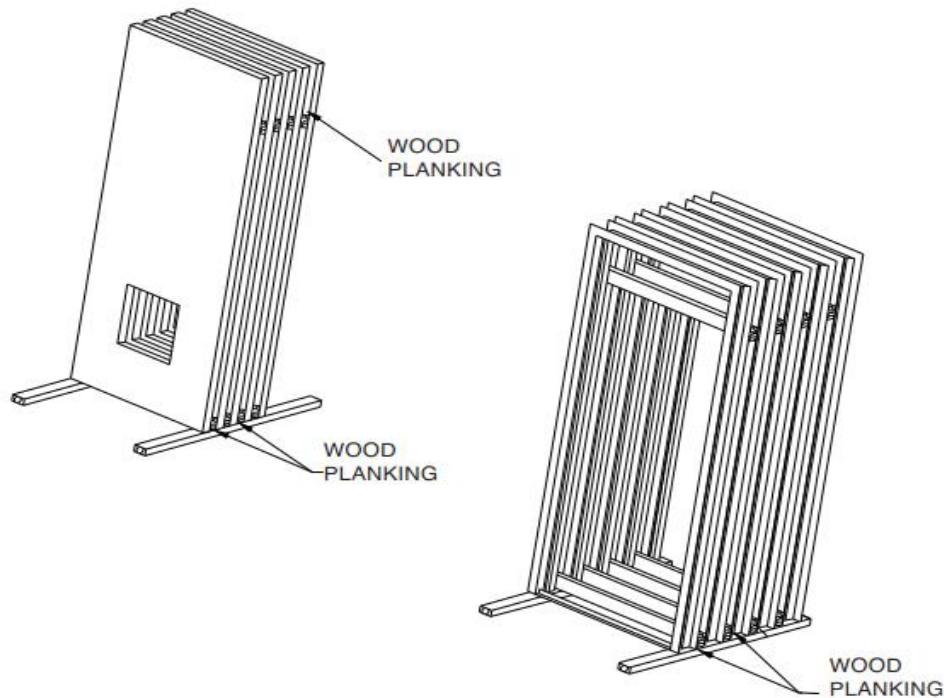
2.6 FINISH

- A. Detention Door Louvers: Fabricate flush louver openings using 3/32" thick, interior steel channels welded to inside of both detention door face sheets and with corners fully welded. Provide welded, inverted V- or Y-shaped vanes allowing specified airflow, fabricated from 3/32" thick steel sheet and spaced so no rigid flat instrument can pass through.

PART 3 - EXECUTION

3.1 SITE STORAGE AND PROTECTION OF MATERIALS

- A. The contractor responsible for installation shall remove wraps or covers from doors and frames upon delivery at the building site. The contractor responsible for installation shall ensure that any scratches or disfigurement caused in shipping or handling are promptly sanded smooth, cleaned and touched up with a compatible rust inhibitive Direct to Metal (DTM) primer.
- B. The contractor responsible for installation shall ensure that materials are properly stored on planks or dunnage in a dry location. Doors and frames shall be stored in a vertical position and spaced by blocking. Figure 2 illustrates recommended storage positioning. Materials shall be covered to protect them from damage but in such a manner as to permit air circulation.

**Figure 2**

3.2 INSTALLATION

The Contractor responsible for installation shall perform the following:

- A. Prior to installation, all frames shall be checked for correct size and swing, and with temporary spreaders removed be corrected for squareness, alignment, twist and plumb. Permissible installation tolerances shall not exceed 1/16 in. (1.5 mm):

Squareness:	Measured at rabbet on a line from jamb, perpendicular to frame head.
Alignment:	Measured at jambs on a horizontal line parallel to the plane of the face.
Twist:	Measured at opposite face corners of jambs on parallel lines, perpendicular to the plane of the door rabbet.
Plumbness:	Measured at jambs on a perpendicular line from the head to the floor.

During the setting of the frames, check and maintain these tolerances for squareness, alignment, twist and plumbness.

The details in Figure 3 illustrate methods of measuring the above specified tolerances.

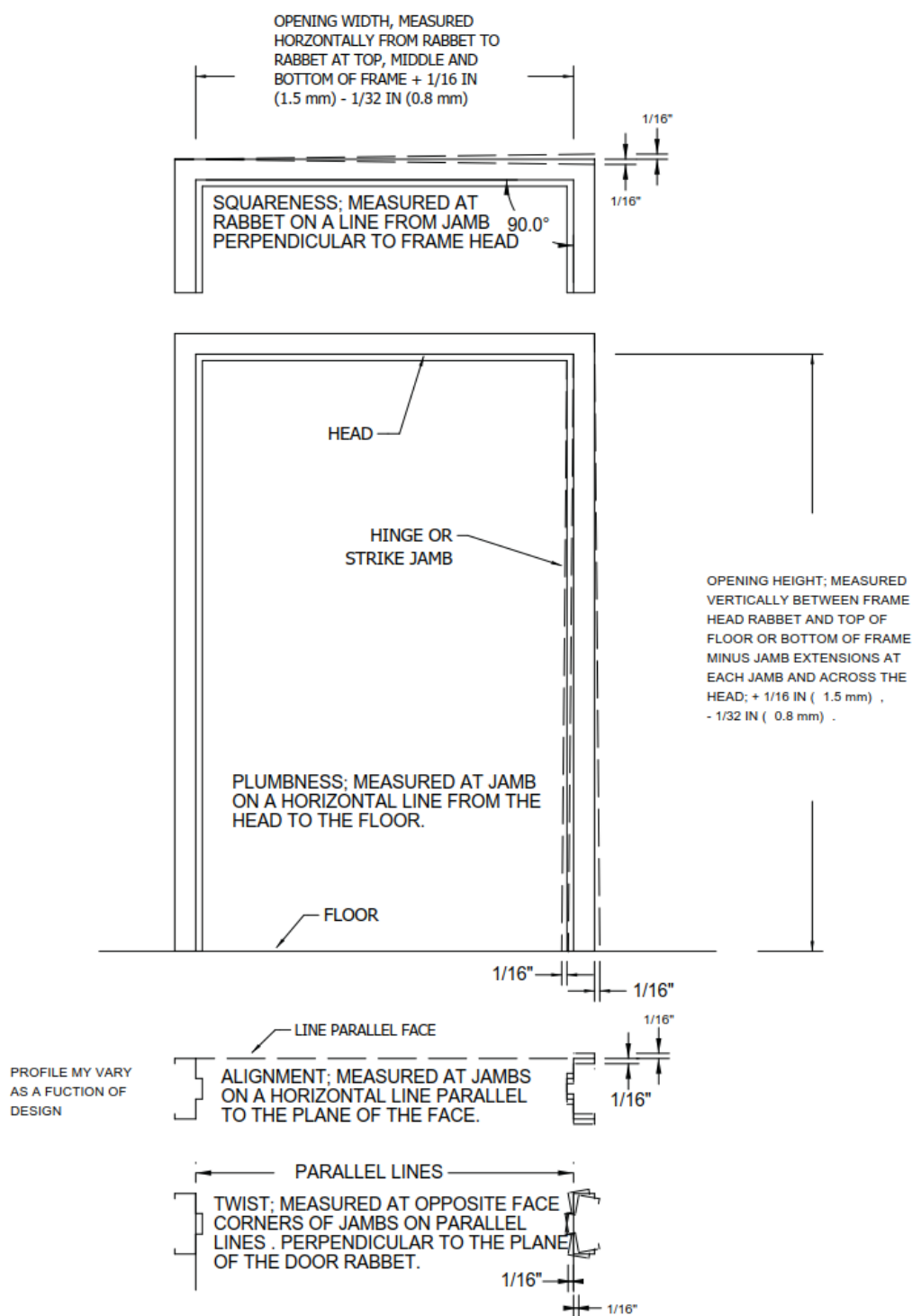


Figure 3
Installation Tolerances

- B. Frame jambs shall be fully grouted to provide added security protection against battering, wedging, spreading and other means of forcing open the door. Jamb mounted lock preparations, grout guards for hardware preparations and glazing stop screws, and junction boxes are intended to protect hardware mortises, exposed removable screws, and tapped mounting holes from masonry grout of 4 in. (102 mm) maximum slump consistency which is hand troweled in place. If a light consistency grout (greater than 4 in. (102 mm) slump in accordance with ASTM C 143 / C 143M) is to be used, special precautions shall be taken in the field by the installation contractor to protect tapped holes, electrical knock-outs, lock pockets, grout guards, junction boxes, etc. in the frames.

Large frame sections, such as lock columns and lock jambs, are not intended or designed to act as forms for grout or concrete. Grouting of large hollow metal sections shall be done in "lifts" or precautions shall otherwise be taken by the contractor to ensure that frames are not deformed or damaged by the hydraulic forces that occur during this process.

- C. Proper door clearances shall be maintained in accordance with 3.03 of these specifications, except for special conditions otherwise noted. Where necessary, metal hinge shims, furnished by the Contractor responsible for installation, are acceptable to maintain clearances.
- D. Hardware shall be applied in accordance with hardware manufacturer's templates and instructions.
- E. Any grout or other bonding material shall be cleaned off of frames or doors immediately following installation. Exposed hollow metal surfaces shall be kept free of grout, tar, or other bonding material or sealer.
- F. Exposed field welds shall be finished smooth and touched up with a rust inhibitive primer.
- G. Primed or painted surfaces which have been scratched or otherwise marred during installation, cleaning, and/or field welding, including marks caused by spreader removal, shall promptly be finished smooth, cleaned, treated for maximum paint adhesion and touched up with a rust inhibitive Direct to Metal (DTM) primer comparable to and compatible with the shop applied primer and finish paint specified in Section 09900. All touch-up primer and finish paint must be formulated for DTM application.
- H. Finish paint in accordance with Section 099000.
- I. Install door silencers.
- J. Install glazing materials in accordance with Section 088000.

3.3 CLEARANCES

- A. Edge clearances for swinging doors shall provide for the functional operation of the assembly and shall not exceed the following:
 - 1. Between doors and frames at head and jambs: 3/16 in. (4.7 mm)
 - 2. Between edges of pairs of doors: 3/16 in. (4.7 mm)
 - 3. At doorsills where a threshold is used: 3/8 in. (9.5 mm)
 - 4. At doorsills where no threshold is used: 3/4 in. (19.1 mm)
 - 5. Between door bottom and nominal surface of floor coverings at fire rated openings as provided in ANSI/NFPA 80, 1/2 in. (12.7 mm).
- B. Clearances for detention sliding doors shall be in accordance with the approved slider device drawings furnished as part of the approved hardware schedule.

END OF SECTION 083220

SECTION 083460

SOUND CONTROL DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Sound rated doors.

1.2 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide door and frame assemblies that have been fabricated as sound-retardant units, tested according to ASTM E 90, and have the following certified STC rating according to ASTM E 413.

1. STC Rating: **Refer to the Door Schedule.**

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's specifications, construction details, materials, dimensions, hardware preparation, gasketing, core, label compliance, sound ratings, profiles, finishes, and installation instructions.
- B. Shop Drawings: Show fabrication, installation, anchorage, and interface of frames with adjacent construction. Include details of each frame type, hardware including sound seals, door bottom, threshold, and door. Indicate location and installation requirements of door and frame hardware and reinforcements.
1. Provide a schedule of doors and frames, using same reference numbers for details and openings as those on the Contract Drawings.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3" by 5".
- D. Certification: Certified laboratory reports, performed in accordance with ASTM E90 and ASTM E 413, from independent testing laboratory qualified under the National Voluntary Laboratory Accreditation Program (NVLAP) supporting compliance of assemblies to specified requirements.
1. Field tests shall be performed in accordance with ASTM E 336 and ASTM E 413 substantiating acoustical performance when installed at no less than four (4) FSTC ratings below the specified STC rating.

- E. Installation Instructions: Provide recommended installation procedures, which, upon approval by the architect, will become the basis for acceptance or rejection of the actual procedures used for installation.
- F. Product Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of sound ratings and fire ratings with requirements indicated.
- G. Material Certificates: Signed by manufacturers certifying that each sound control door complies with requirements.
- H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed sound control doors.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing sound control doors assemblies similar to those indicated for this Project and with a record of successful in-service performance.
- B. Acoustical Testing Agency Qualifications: An independent testing agency that is an acoustical laboratory accredited by the National Voluntary Laboratory Accreditation Program of NIST.
- C. Sound-Rated Door Assemblies: Provide sound control doors that are identical to assemblies whose STC ratings are determined per ASTM E 90 and ASTM E 413 by a qualified independent acoustical testing agency.
- D. Fire-Rated, Sound-Control Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
 - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
- E. Source Limitations: Obtain sound control doors and frames, including gasketing, thresholds, hinges (when integral with design), and other appurtenances essential for sound control, from a single manufacturer specializing in producing this type of work, unless otherwise approved by the Owner's Authorized Representative.
- F. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to sound-control door assemblies including, but not limited to, the following:
 - 1. Review required field quality-control procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames with sound seals palletized, wrapped, or crated to provide protection during transit and storage.
- B. Examine doors and frames on delivery for damage. Minor damage may be repaired provided refinished items are equal in all respects to new work and are approved by the Owner's Authorized Representative; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4" high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4" space between each stacked door to permit air circulation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet sound rating requirements.
 - b. Faulty operation of sound seals.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
 - d. Wood doors that are warped (bow, cup, or twist) more than 1/4" in a 42"-by-84" section, or show telegraphing of core construction in face veneers exceeding .009" in a 3" span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
- B. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - 1. Solid-Core Interior Doors: Two years.

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. Sound-Control Door Assemblies with Steel Doors:
 - a. Ambico Limited.
 - b. Amweld Building Products, LLC.
 - c. Ceco Door Products; an ASSA ABLOY Group Company.
 - d. CURRIES Company; an ASSA ABLOY Group Company.
 - e. Overly Door Company.
2. Sound-Control Door Assemblies with Wood Doors:
 - a. Ambico Limited.
 - b. Krieger Steel Products Co.
 - c. Overly Door Company.
 - d. Security Acoustics; Div. of Security Metal Products Corp.

2.2 WOOD DOORS

- A. Provide flush-design wood doors, not less than 1-3/4" thick; with manufacturer's standard sound-retardant core as required to provide STC rating indicated. Fabricate wood doors with tolerances according to WDMA 1.S.1-A.
- B. Comply with Division 8 Section "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements.

1. Stiles: Same species as faces.

2.3 STEEL FRAMES

- A. General: Fabricate sound-control door frames of full-welded unit construction, with corners mitered, reinforced, and continuously welded full depth and width of frame. Knocked-down frames are not acceptable.
 1. Interior Frames: Formed from minimum 1/16" thick, cold-rolled steel sheet, unless otherwise indicated.
- B. Hardware Reinforcement: Fabricate reinforcement plates from same material as door frame to comply with the following minimum sizes:
 1. Hinges: Minimum 0.16" thick by 1-1/2" wide by 6" longer than hinge, secured by not less than 6 spot welds.
 2. Strikes and Closers: Minimum 3/32" thick.
 3. Surface-Mounted Hardware: Minimum 3/32" thick.
- C. Head Reinforcement: Minimum 3/32"- thick, steel channel or angle stiffener.
- D. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed of same material as frame, not less than 1/2" thick, with corrugated or perforated straps not less than 2" wide by 10" long; or wire anchors not less than 0.16" wide.
 2. Stud Wall Type: Designed to engage metal stud, welded to back of frames; formed of same material as frame, not less than 0.04" thick.
 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8" diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall with throat reinforcement plate, welded to frame at each anchor location.
- E. Floor Anchors: Formed of same material as door frame, not less than 1/16" thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2" height adjustment. Terminate bottom of frames at finish floor surface.
- F. Ceiling Struts: Minimum 3/8" thick by 2" wide steel.
- G. Plaster Guards: Same material as frame, not less than 0.023" thick.
- H. Miscellaneous Components: Fabricated from hot- or cold-rolled steel sheet.

2.4 DOOR HARDWARE

- A. General: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC rating indicated. Also see Section 087100 Door Hardware.
- B. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- C. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
- D. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
1. Mounting: Mortised or semimortised into bottom of door or surface mounted on face of door as required by testing to achieve STC rating indicated.
- E. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.

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

2.5 FABRICATION

- A. General: Assemble sheet steel work using all welded construction conforming to applicable requirements of AWS D1.1.
- B. Wood Doors: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to referenced quality standard, unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
 - 1. Comply with clearance requirements in NFPA 80 for fire-rated doors.
- C. Steel Frames: Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 - 2. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound-control seal preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.
 - 3. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18" from top and bottom of frame. Space anchors not more than 32" o.c. and as follows:
 - 1) Two anchors per jamb up to 5'-0" in height.
 - 2) Three anchors per jamb from 5'-0" up to 7'-6" in height.
 - 3) Four anchors per jamb from 7'-6" up to 8'-0" in height.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 2'-0" or fraction thereof more than 8'-0" in height.
 - b. Stud Wall Type: Locate anchors not more than 18" from top and bottom of frame. Space anchors not more than 32" o.c. and as follows:
 - 1) Three anchors per jamb up to 5'-0" in height.
 - 2) Four anchors per jamb from 5'-0" up to 7'-6" in height.

- 3) Five anchors per jamb from 7'-6" up to 8'-0" in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 2'-0" or fraction thereof more than 8'-0" in height.
 - 5) Two anchors per head for frames more than 42" wide and mounted in metal stud partitions.
- c. Postinstalled Expansion Type: Locate anchors not more than 6" from top and bottom of frame. Space anchors not more than 26" on center.
6. Head Reinforcement: For frames more than 48" wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
- D. Hardware Preparation:
1. Steel Doors and Frames: Factory prepare sound-control doors and frames to receive templated mortised hardware, including providing cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
 - a. Reinforce doors and frames to receive non-templated mortised and surface-mounted door hardware.
 - b. Comply with HMMA 830, "Hardware Preparation and Locations for Hollow Metal Doors and Frames."
 - c. Locate door hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
 2. Wood Doors: Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.

2.6 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish sound-control steel door assemblies after assembly.
- B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond.

Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.708 mils.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2.7 WOOD FINISHES

- A. Finish sound-control wood doors after assembly.
- B. Factory finish sound-control wood doors to match doors specified in Division 8 Section "Flush Wood Doors."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare wall openings to receive door and frame assemblies according to manufacturer's written instructions after wet construction is complete and dry.
- B. Frames: Before installation, verify that frames are correct size and swing and that squareness, alignment, twist, and plumbness tolerances comply with HMMA 865.

3.3 INSTALLATION

- A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
- C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.
- D. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16", measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16", measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16", measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16", measured at jambs on a perpendicular line from head to floor.
- E. Fill voids between concealed side of frame and adjacent wall construction with lightweight gypsum plaster in accordance with approved shop drawings or manufacturer's printed installation instructions.
- F. Hardware: Install and adjust according to hardware manufacturer's written instructions.
 - 1. Thresholds: Set thresholds in full bed of sealant complying with requirements in Division 7 Section "Joint Sealants."
- G. Touchup: Immediately after installation, sand smooth any rusted or damaged areas of door or frame and touch up with compatible finish system.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent acoustical testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Test all doors that are completely installed and perform testing for verification that assembly complies with STC rating requirements.
 - 1. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field STC values shall be within 5 dB of laboratory STC values.
 - 2. Inspection Report: Testing and inspecting agency shall submit report in writing to Architect and Contractor within 24 hours after testing.

- C. Remove and replace sound-control door assemblies where test results indicate that they do not comply with specified STC rating requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING AND CLEANING

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

END OF SECTION 083460

SECTION 087100

DOOR HARDWARE

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. The work of this Section includes securing and furnishing to the job site all Finish Hardware in accordance with this section and applicable drawings.
- B. It is intended that the following list of hardware and electronics establish a quality standard and cover all items required to complete the responsibility of this Section. Omissions and/or discrepancies shall be brought to the Design Professional's attention during the bidding period and, as needed, be corrected by addendum.
- C. Items covered include, but are not necessarily limited to:

PRODUCTS

MANUFACTURER

Armor Plates	Ives
Astragals	Pemko
Closers	LCN
Deadbolts	Schlage
Dead Latches	Kaba Mas
Door Position Switches	Sentrol
Door Release Button	Locknetics
Electric Strikes	Von Duprin
Exit Devices	Von Duprin
Hinges	Hager
Keys	Schlage
Kickplates	Ives
Locks and Latches	Schlage
Lock Cylinders	Schlage,
Magnetic Locks	Locknetics
Magnetic Holders	LCN
Motion Sensor	Sentrol
Mutes	Ives
Overhead Stops	Glynn Johnson
Power Supplies	Von Duprin, Locknetics
Pull Plates	Ives
Pulls	Ives
Push Buttons	Locknetics
Push Plates	Ives
Sound/Smoke Seals	Pemko
Stops (Wall and Floor)	Ives
Surface Bolts	Ives
Thresholds	Pemko
Weatherstripping	Pemko

1.2 REFERENCES:

- A. State and Local Codes including Authority having jurisdiction.
- B. Florida Building Code
- C. ANSI 156.18 - Materials and Finishes.
- D. ANSI 117.1 - Specifications for Making Buildings and Facilities Usable by Physically Handicapped People.
- E. Florida Accessibility Code for Building Construction.
- F. ADA - Americans with Disabilities Act of 1990.
- G. BHMA - Builders Hardware Manufacturers Assoc.
- H. NFPA - National Fire Protection Assoc.
 - 1. NFPA80 - Fire Doors and Windows
 - 2. NFPA101 - Life Safety Code
- I. SDI - Steel Door Institute
- J. WDI - Wood Door Institute

1.3 SUBMITTALS:

- A. The project contractor must coordinate with County Telecommunications Staff, Manny Cabo and Ryan Franklin, regarding the Securitas work, and all shop drawing submittals for doors must be coordinated with County Staff and Securitas Staff to make sure the correct doors are obtained.
- B. Submit 6 copies of vertically formatted Hardware Schedule in accordance with General Conditions.
- C. Format Hardware Schedule into Hardware Groups to clearly identify each door and frame with the following.
 - 1. Unique number; Descriptive location; Size; Hand and degree of swing.
- D. List within Hardware Groups all items required for each door or pair of doors, including the following.
 - 1. Quantity; Item description; Manufacturers name and catalog number; Size: BHMA finish.
- E. Furnish numerically sorted cross-reference of door numbers to Hardware Groups.

- F. Furnish 4 copies of catalog cuts for each item of hardware.
- G. Furnish index and explanation of abbreviations, symbols and/or codes contained in Hardware Schedule.
- H. Furnish chart of mounting heights and locations.
- I. Provide templates to manufacturer's indicating location and reinforcing required for hardware items.
- J. Approval of the Hardware Schedule will not relieve this supplier's responsibility of furnishing all hardware to complete the project.

1.4 COORDINATION:

- A. Furnish templates and approved Hardware Schedule in a timely manner to respective material suppliers and trades to ensure accurate reinforcing and fitting of finish hardware.

1.5 QUALITY ASSURANCE:

- A. Supplier to be a directly franchised distributor of the products to be furnished with warehousing facilities within 50 miles of the project. An AHC, Architectural Hardware Consultant, or person of equivalent experience shall be in their employ and available for consultation to the Architect, Owner and General Contractor at reasonable times during the course of work.
- B. Single Source Responsibility: Obtain each category of hardware; (lockset latchset, deadbolt); (hinges); (closers), etc. from a single manufacturer when possible.
- C. Hardware for fire rated openings shall comply with NFPA80, State and Local Fire Safety Codes.
- D. Hardware shall comply with requirements of the Americans With Disabilities Act, ADA, and A117.1.
- E. MANUFACTURER'S SHALL SUPPLY BOTH PRE-INSTALLATION INSTRUCTION AND POST INSTALLATION WALK THRU TO INSURE PROPER FUNCTION AND INSTALLATION OF HARDWARE ITEMS. RECOMMENDATIONS, AS NEEDED, WILL BE MADE FOR ADJUSTMENT OR REPLACEMENT OF ANY ITEMS DEEMED UNACCEPTABLE.

1.6 DELIVERY, STORAGE AND IDENTIFICATION:

- A. Package hardware items individually in manufacturer's original Cartons clearly marked to indicate contents and cross referenced to Hardware Schedule.
- B. Deliver, Store and protect all items under provisions of the General Conditions. Provide a locked storage area protected from moisture, sunlight paint and chemicals.

1.7 MAINTENANCE:

- A. Furnish four (4) copies of any specialized tools and maintenance instruction manuals to Owner's Representative. Manuals are to be bound in three ring binders. Incorporate a master index at the front and separation of manufacturer's products w/ plastic tabs.

1.8 WARRANTY:

- A. Provide a one (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project. Extended warranties are specifically mentioned in each product category.

PART 2 PRODUCTS:

2.1 FINISHES:

- A. As noted in Hardware Groups

2.2 MATERIALS AND FABRICATION:

- A. Manufacturer's Name: Manufacturer, or trade name, shall not be displayed in a visible location, except in conjunction with required UL labels and face of lock cylinders.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

Provide Phillips flat or pan head screws except as otherwise Furnish screws for installation with each hardware item indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

Furnish concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

2.3 HINGES

- A. Types and sizes as noted in Hardware Groups.
- B. Provide shims and instructions for proper door adjustment.
- C. Provide a three (3) years warranty against defects in materials and workmanship.

- D. Stanley and Ives are acceptable alternates in this product category.

2.4 CONTINUOUS HINGES

- A. Types and sizes as noted in Hardware Groups.
- B. Hinge shall be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising. The door and jamb leaf shall be geared together for the entire length of the hinge and joined by a channel. Hinge knuckle shall be monolithic in appearance. Continuous hinge with visible knuckle separations are not acceptable. The door leaf and jamb leaf shall have templated screw hole locations for future replacement needs. All heavy-duty hinges (HD) shall have a minimum of 32 bearings for a 6.8 feet length.

2.5 LOCKS AND LATCHES:

- A. Types, functions and designs as noted in Hardware Groups.
- B. Mortise type – ANSI A156.13, 1994, Grade 1 Operational, Grade 2 Security, ANSI/ASTM F476-76 Grade 30, UL listed. Levers shall be forged or cast stainless steel. Provide steel case with 3/4" throw stainless steel anti-friction latch bolt and a 1" throw stainless steel deadbolt. Lock case to be field reversibility without opening the lock chassis. Lock spindles shall incorporate two independent inside and outside spindles to prevent manipulation of lock. Lock trim shall incorporate individual lever support springs in each rose or. Lever connection shall be accomplished using threaded bushings tightened by a spanner wrench. Set screws are not acceptable.

Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect the frame.

2.6 KEYING, KEYS:

- A. Create a new key system for this project.
- B. Furnish all locks with Primus-Everest, Level 9, High Security, Interchangeable Core, pin tumbler cylinders with patent protected keys. Key blank availability shall be by Owner Signature Card only.
- C. Ship all permanent cylinders and key blanks directly to the Owner.
- D. Construction Keying: Provide temporary keying for the construction period with all cylinders keyed alike. As portions of the building are completed the General Contractor, in concert with the Owner's representative, shall replace the temporary cores with permanent cores. All temporary cores shall be returned to the supplier for credit.
- E. Keys: Furnish the following:
 - 1. 2 keys each lock or cylinder keyed differently.
 - 2. 4 keys each keyed alike Group

3. 4 Master keys each master key Set
4. 5 Temporary Construction keys.
5. 5 Control keys
6. 10 key blanks.

2.7 EXIT DEVICES:

- A. Types and functions as noted in Hardware Groups.
- B. General: All devices shall be furnished non-handed and capable of direct field conversion for all available trim functions.
- C. Warranty: All devices shall carry a three-year warranty against manufacturing defects and workmanship.
- D. Exit device(s) submitted for approval shall have been manufactured for at least 10 years. A list of (10) years old projects using proposed exit device shall be available upon request.
- E. Springs: Only minimum 1/16" diameter compression springs are acceptable. All internal parts shall be zinc dichromate coated to prevent rusting.
- F. Quiet Feature: All devices shall incorporate a hydraulic sound damper to which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation.
- G. Touch Pad: Shall be architectural metal with a minimum height of 2". Plastic is not acceptable.
- H. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru-bolts from the inside. Lever trim shall be forged brass with a minimum average thickness on the escutcheon of 1/8". Plate with pull shall be minimum average thickness of 3/32" and have forged pulls. Exterior lever trim shall be furnished with "Break-Away Levers" 994L Trim.
- I. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal and have a minimum thickness of 1/4". Plastic or metal stamping will not be acceptable.
- J. Mounting: Provide shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.
- K. Latches: Furnish all exit devices with deadlocking latchbolts.

2.8 CLOSERS:

- A. Types and sizes as noted in Hardware Groups.

- B. All door closers shall be non-handed, non-sized, hydraulic, full rack and pinion construction. Pinion and pistons shall be hardened regardless of closer size. The closer shall incorporate tamper resistant non-critical screw valves of V-slot design to reduce possible clogging. Closer shall have separate and independent screw valve adjustments for latch speed, general speed and hydraulic backcheck. Backcheck 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. Pressure relief valves are not acceptable.
- C. Cylinder shall be of high strength cast iron construction and tested to ANSI/BHMA A156.4 requirements by a BHMA certified independent testing laboratory. Written certification showing successful completion of a minimum of 10,000,000 cycles for all door closers must be provided. Cylinders shall have been manufactured and in the marketplace for a minimum of 10 years.
- D. All door closers shall pass UL10C positive pressure fire test.
- E. Warranty: Provide a manufacturer's TEN-YEAR WARRANTY against defects in material and workmanship.
- F. Closers Arms: Provide in forged steel with bronze bushings.
- G. Built-In Stops: Where closers with built-in positive stops are used, the stops shall be of one piece cast iron material. Screw on stops of any kind are not acceptable. Where required, the hold-open assembly handle for these stops shall rotate on ball bearings.
- H. Finishes: All closers to have a powder coat finish on closer body, arm, metal cover and adapter plate. Powder coat finish shall exceed a minimum 100-hour salt spray test, as described in ANSI Standard A156.4 and ASTM B117.
Hydraulic Fluid: All closers, shall utilize temperature stable fluid capable of withstanding temperature ranges of 42 degrees C to -34 degrees C without requiring seasonal adjustment of closer speed to properly close the door.
- I. Covers: All door closers shall be furnished with metal covers.
- J. Miscellaneous: Supply all drop plates, shoe supports, templates, etc. to properly install closers according to manufacturer's recommendations.

2.9 PUSH PLATES, PULL PLATES, KICK PLATES AND ARMOR PLATES

- A. Types as noted in Hardware Groups.
 - 1. 8200 Push Plates: 8 X 16 B4E O50
 - 2. 8300 Pull Plates: 8103EZ X TB / 4 X 16 B4E 050
 - 3. 8400 Kick Plates: 10 X 2" LDW B4E 050 (single)
10 X 1" LDW B4E 050 (pair)
 - 4. 8400 Armor Plates 40 X 1" LDW B4E 050 (pair)

- B. Rockwood and Quality are acceptable alternates in this product category.

2.10 THRESHOLDS, SADDLES, DOOR BOTTOMS, WEATHERSTRIPPING, SOUND SEALS:

- A. Types as noted in Hardware Groups.
- B. Where not specifically noted in Hardware Groups, refer to drawings for sill conditions and saddles/ thresholds required.
- C. National Guard and Hager are acceptable alternates in this product category.

2.11 OR EQUAL PROVISION

- A. The Contractor shall be responsible for supplying the product(s) listed as the quality standard, or alternate(s), which are equal to the specified product(s) in regards to function, quality, finish, size, accessories, options, durability, warranty, parts availability and listing approvals. If it is determined by the Owner or its appointed representative, at any time during the bidding review, construction or installation, and prior to the final acceptance of the Project, that the alternate(s) submitted by the Contractor are not equal to the quality standard listed, the Contractor shall assume all costs to replace the alternate(s) submitted with approved Equals. Monetary compensation for the differing value shall not be considered
- B. The bidders shall submit a list of any alternates they propose noting both specified product and alternate by model number and manufacturer. Physical samples as necessary may be required.

PART 3 EXECUTION:

3.1 INSPECTION:

- A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION:

- A. Utilize instructions and templates provided with each item of hardware. Where cutting and fitting is required to install hardware onto or into surfaces that are to be later painted or finished in another way, coordinate removal, storage and reinstallation of hardware items with finishing work specified in Division 9. Do not install surface mounted items until finishes have been completed on the substrates involved.
- B. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with other governing regulations.

1. Recommended Locations for Builders Hardware for Standard Steel Doors and Frames X DHI.
 2. NWWDA Industry Standard I.S. 1.7, Hardware Locations for Wood Flush Doors.
 3. ADAG – Americans with Disabilities Act Guidelines
 4. FACBC – Florida Accessibility Code for Building Construction.
- C. Set units level and plumb. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchoring or fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic.

3.3 ADJUST AND CLEAN:

- A. Check and adjust the operation of each door and item of hardware to ensure proper function and operation. Replace units that cannot be adjusted to operate freely and smoothly.
- B. Final adjustments are to be made after all ventilating systems are in operation.
- C. Clean all hardware items and adjacent surfaces after installation.
- D. Where door hardware is installed more than one month prior to acceptance of the space all items shall be revisited to assure operation and cleanliness.

3.4 HARDWARE GROUPS

Provide each SGL door(s) with the following:

Door/Hardware Index

Courtroom

Door #	HWSet #
117-1	01
119-1	07
117-2	08
116-1	12
118-1	01
118-4	09
118-2	10
118-3	11
118-5	11
115-1	10
114-2	12
114-1	13
113-1	14

RECORDS

Door #	HWSet #
100-1	03
101-1	02
102-1	02
103-1	06
104-1	15
105-1	04
106-1	04
108-1	04
109-1	02
100-2	02
110-1	05
111-1	05

Project: Indian River County Courtroom Renovation	Control #: 336640	Print Date: May 26 2017 6:41AM EDT	
Company: Allegion,PLC	Version #: 2	Ver Date: May 26 2017 3:28AM EDT	Page 1 of 2

Door/Hardware Index

Courtroom

Door #	HWSet #
217-1	01
219-1	07
217-2	08
216-1	12
218-1	01
218-4	09
218-2	10
218-3	11
218-5	11
215-1	10
214-2	12
214-1	13
213-1	14
212-1	14

RECORDS

Door #	HWSet #
100-1	03
100-2	03
101-1	02
102-1	02
103-1	06
104-1	15
105-1	04
106-1	04
108-1	04
109-1	02
100-2	02
110-1	05
111-1	05

Project: Indian River County Courtroom Renovation	Control #: 336640	Print Date: May 26 2017 6:41AM EDT	
Company: Allegion,PLC	Version #: 2	Ver Date: May 26 2017 3:28AM EDT	Page 2 of 2

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SpeXtra # 336640

Heading 01

1 SGL DOOR(S) 118-1

SECURE VESTIBULE / JUDGE'S VESTIBULE 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

1 SGL DOOR(S) 117-1

CORRIDOR / JUDGE'S VESTIBULE 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X RATED

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		
0			CARD READER - WORK OF DIVISION 28		

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems
Self-Closing.

Heading 02

1	SGL	DOOR(S) 101-1	OFFICE / PUBLIC RECORDS 0 DEG
1	SGL	DOOR(S) 102-1	OFFICE / IT 0 DEG
1	SGL	DOOR(S) 109-1	OFFICE / FILES 0 DEG
1	SGL	DOOR(S) 100-2	OFFICE / PUBLIC RECORDS 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD			

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		
0			CARD READER - WORK OF DIVISION 28		

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems
Self-Closing.

Heading 03

1 SGL DOOR(S) 100-1

OFFICE / PUBLIC RECORDS 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS439	682	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		
0			CARD READER - WORK OF DIVISION 28		

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems
Self-Closing.

Heading 04

1 SGL DOOR(S) 105-1
1 SGL DOOR(S) 106-1
1 SGL DOOR(S) 108-1

OFFICE / BREAKROOM 0 DEG
OFFICE / OFFICE 0 DEG
VESTIBULE / WITNESS 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

0			EXISTING DOOR, FRAME AND HARDWARE TO REMAIN		
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Heading 05

1 SGL DOOR(S) 110-1

INTERIOR CORRIDOR / MEDIATION 0 DEG

1 SGL DOOR(S) 111-1

INTERIOR CORRIDOR / ROOM 0 DEG

3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.

Heading 06

1 PD DOOR(S) 103-1

3' 0" X 7' 0" X 1 3/4" X WD X WDF X NONRTD

Each Assembly to have:

2	EA	FLUSH PULL	227	626	IVE
1	EA	DOOR EDGE PULL	230	626	IVE
0			BALANCE OF HARDWARE BY FRAME MANUFACTURER		

Heading 07

1 SGL DOOR(S) 119-1

CORRIDOR / COURT ROOM 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X RATED

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC DELAYED FIRE EXIT HARDWARE	CX-98-L-F-E996-06-FSE-SNB	626	VON
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX XQ11-948	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		
1	EA	POWER SUPPLY	PS904	LGR	VON
2			CARD READER - WORK OF DIVISION 28		

Delayed egress exit device system - Depressing pushbar for designated amount of time begins irreversible alarm cycle. Upon completion of alarm cycle free egress is allowed. Device can be armed, reset or disarmed by key or access control. (Delayed egress restrictions per local code requirements). When Chexit is armed outside lever is locked, no key override. When Chexit and trim are shunted by control contact, lever will retract latchbolt. Key retracts latchbolt only when Chexit is disarmed. When Chexit is armed outside lever is locked, no key override. When Chexit is disarmed, key locks and unlocks lever. Latchbolt retracted by lever when unlocked. Delay 15 Seconds. Electrically unlocked.

Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Heading 08

1 SGL DOOR(S) 117-2

COURT ROOM / JUDGE'S VESTIBULE 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.

Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Heading 09

1 SGL DOOR(S) 118-4

0 DEG
3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD

Each Assembly to have:

0			HARDWARE BY DOOR / FRAME MANUFACTURER		
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DETENTION DOOR

Heading 10

1 SGL DOOR(S) 118-2
1 SGL DOOR(S) 115-1

COURT ROOM / SECURE VESTIBLE 0 DEG
COURT ROOM / EVIDENCE 0 DEG
3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080P 06A	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

security door

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always inoperative. Auxiliary latch deadlocks latchbolt when door is locked. Inside lever is always free for immediate egress.
Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Heading 11

1 SGL DOOR(S) 118-3
1 SGL DOOR(S) 118-5

CORRIDOR / SECURE VESTIBLE 0 DEG
INTERIOR CORRIDOR / SECURE VESTIBLE 0 DEG
3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080P 06A	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	

1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

evidence door requirements
INCLUDED?

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always inoperative. Auxiliary latch deadlocks latchbolt when door is locked. Inside lever is always free for immediate egress.
Self-Closing.

Heading 12

1 PR DOOR(S) 116-1
1 PR DOOR(S) 114-2

COURT ROOM / GALLERY
VESTIBULE / GALLERY
2/3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	SET	PUSH/PULL BAR	9190HD-12"-NS	630	IVE
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

INCLUDE ?

Self-Closing.

Heading 13

1 PR DOOR(S) 114-1

CORRIDOR / VESTIBULE
2/3' 0" X 7' 0" X 1 3/4" X WD X HMF X RATED

Each Assembly to have:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9827-EO-F-LBR-499F-SNB	626	VON
1	EA	FIRE EXIT HARDWARE	9827-L-F-LBR-06-499F-SNB	626	VON
1	EA	RIM CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER

Free Egress at all times. Pressing Push Bar retracts latchbolts. No exterior trim.

Free Egress at all times. Pressing Push Bar retracts latchbolts. Latchbolt retracted by lever unless locked by key. Key locks and unlocks lever.

Self-Closing.

Heading 14

1 SGL DOOR(S) 113-1

VESTIBULE / WITNESS 0 DEG
3' 0" X 7' 0" X 1 3/4" X WD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
---	----	-------	----------------	-----	-----

1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	OH STOP	450S	630	GLY
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.
Self-Closing.

Heading 15

1 SGL DOOR(S) 104-1

BREAKROOM / RESTROOM 0 DEG
3' 0" X 7' 0" X 1 3/4" X HMD X HMF X NONRTD

Each Assembly to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

security door

Latchbolt retracted by knob/lever from either side unless outside is locked by inside thumbturn. Turning inside knob/lever or closing door unlocks outside knob/lever. To unlock from outside, remove emergency button, insert emergency thumbturn(furnished) in access hole and rotate. Inside lever is always free for immediate egress. ADA Thumbturn. Lock Indicator will read OCCUPIED/VACANT
Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

SpeXtra: 336640

Hardware Group No. 01

For use on mark/door #(s):

117-1 118-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		

CARD READER - WORK OF DIVISION 28

Operational Description

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems

Self-Closing.

Hardware Group No. 02

For use on mark/door #(s):

101-1 102-1 109-1 100-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		

CARD READER - WORK OF DIVISION 28

Operational Description

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems

Self-Closing.

Hardware Group No. 03

For use on mark/door #(s):

100-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092PEU 06A RX	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS439	682	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		

CARD READER - WORK OF DIVISION 28

Operational Description

Outside lever electrically unlocked (fail secure) by 12 or 24V DC with Allegion Connect molex 3" lead connector. Outside key allows manual retraction of latchbolt. Inside lever always free for immediate egress. Auxiliary latch deadlocks latchbolt when locked. The RX switch signals the use of that opening to security systems

Self-Closing.

Hardware Group No. 04

For use on mark/door #(s):

105-1

106-1

108-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
			EXISTING DOOR, FRAME AND HARDWARE TO REMAIN		

Hardware Group No. 05

For use on mark/door #(s):

110-1

111-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.

Hardware Group No. 06

For use on mark/door #(s):

103-1

Provide each PD door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	FLUSH PULL	227	626	IVE
1	EA	DOOR EDGE PULL	230	626	IVE
BALANCE OF HARDWARE BY FRAME MANUFACTURER					

Hardware Group No. 07

For use on mark/door #(s):

119-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC DELAYED FIRE EXIT HARDWARE	CX-98-L-F-E996-06-FSE-SNB	626	VON
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX XQ11-948	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR POSITION SWITCH	PREPARE DOOR AND FRAME		
1	EA	POWER SUPPLY	PS904 900-BBK 900-4RL-FA KL900	LGR	VON
2		CARD READER - WORK OF DIVISION 28			

Operational Description

Delayed egress exit device system - Depressing pushbar for designated amount of time begins irreversible alarm cycle. Upon completion of alarm cycle free egress is allowed. Device can be armed, reset or disarmed by key or access control. (Delayed egress restrictions per local code requirements). When Chexit is armed outside lever is locked, no key override. When Chexit and trim are shunted by control contact, lever will retract latchbolt. Key retracts latchbolt only when Chexit is disarmed. When Chexit is armed outside lever is locked, no key override. When Chexit is disarmed, key locks and unlocks lever. Latchbolt retracted by lever when unlocked. Delay 15 Seconds. Electrically unlocked. Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Hardware Group No. 08

For use on mark/door #(s):
117-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.

Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Hardware Group No. 09

For use on mark/door #(s):
118-4

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
			HARDWARE BY DOOR / FRAME MANUFACTURER		

DETENTION DOOR

Hardware Group No. 10

For use on mark/door #(s):
118-2 115-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080P 06A	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Security door

Operational Description

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always inoperative.
Auxiliary latch deadlocks latchbolt when door is locked. Inside lever is always free for immediate egress.
Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

Hardware Group No. 11

For use on mark/door #(s):

118-3 118-5

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080P 06A	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always inoperative.
Auxiliary latch deadlocks latchbolt when door is locked. Inside lever is always free for immediate egress.
Self-Closing.

Hardware Group No. 12

For use on mark/door #(s):

116-1 114-2

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	SET	PUSH/PULL BAR	9190HD-12"-NS	630	IVE
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Operational Description

Self-Closing.

Hardware Group No. 13

For use on mark/door #(s):

114-1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9827-EO-F-LBR-499F-SNB	626	VON

1	EA	FIRE EXIT HARDWARE	9827-L-F-LBR-06-499F-SNB	626	VON
1	EA	RIM CYLINDER	BLDG STANDARD	626	
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER

Operational Description

Free Egress at all times. Pressing Push Bar retracts latchbolts. No exterior trim.

Free Egress at all times. Pressing Push Bar retracts latchbolts. Latchbolt retracted by lever unless locked by key. Key locks and unlocks lever.

Self-Closing.

Hardware Group No. 14

For use on mark/door #(s):

113-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 06A L583-363	626	SCH
1	EA	MORT. CYLINDER	BLDG STANDARD	626	
1	EA	OH STOP	450S	630	GLY
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description

Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key Outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. ADA Thumbturn.

Self-Closing.

Hardware Group No. 15

For use on mark/door #(s):

104-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description

Latchbolt retracted by knob/lever from either side unless outside is locked by inside thumbturn. Turning inside knob/lever or closing door unlocks outside knob/lever. To unlock from outside, remove emergency button, insert emergency thumbturn (furnished) in access hole and rotate. Inside lever is always free for immediate egress. ADA Thumbturn. Lock Indicator will read OCCUPIED/VACANT

Self-Closing. Templating allows CUSH Arm to stop the door's swing between 85 and 110 degrees.

END OF SECTION 087100

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SECTION 087810

DETENTION DOOR HARDWARE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section includes furnishing and installing detention hardware and related accessories required to complete the work as shown on the drawings, schedules and as specified herein. This Section includes:
 - 1. Steel Detention Doors
 - 2. Steel Detention Door Frames
 - 3. Detention Door Accessories

1.2 REFERENCES

- A. ASTM F 1577-05 Test Methods for Detention Locks for Swing Doors
- B. National Electrical Code, latest edition, for internal electrical requirements for hardware
- C. UL 10B-2001
- D. UL 10C-2001

1.3 SUBMITTALS

- A. Make submittals in accordance with the requirements of Division 1 Section "Submittals".
- B. Submit specifications, installation instructions and general recommendations for products as required, including locks, hinges, and lock mount covers, bolt keepers, wall bumpers, weatherstripping, thresholds, escutcheons, etc.

- C. Hardware and Keying Schedules:

Submit one copy of each schedule type; indicate all products by name and number for each separate opening. Include all other pertinent hardware and keying information

- 1. DEC is required to coordinate a detention keying meeting with the architect and user so as not to delay the manufacturer and delivery of the required detention equipment.
- 2. Make promptly, any corrections or changes necessary in schedules to comply with requirements; resubmit one copy of revised schedules.

D. Templates for Fabrication:

1. DEC is required to forward templates for each type of detention equipment hardware required to fabricators following final review of hardware and keying schedules.
2. DEC is required to submit wiring diagrams for all electrical devices provided herein.

E. Locking Device Submittals:

Indicate layout plans of each opening, show anchorage and accessory items, dimensions and finishes.

F. Operating and Maintenance Manual Submittals - Furnish three copies of Operating/ Maintenance Manuals including parts lists for security locks and locking devices.

1.4 QUALITY ASSURANCE

In order to establish standards of quality and performance, the following requirements have been established for approval for each type of product listed.

1. Manufacturers Qualifications: Provide detention equipment products from manufacturers who have been actively engaged in the production of security equipment for a minimum of ten (10) years in successfully completing projects of equal scope and magnitude with products as herein specified. This evidence shall consist of a list of ten (10) projects of equal scope and magnitude that have been complete and operational for a minimum of five (5) years. The manufacturer shall now be actively engaged in the design and manufacture of security locks, locking devices, and miscellaneous detention hardware and products. All locks, locking devices and related detention hardware shall be manufactured and supplied by the same manufacturer.
2. Five (5) copies of manufacturer's product specifications and catalog cut sheets and detail and performance data for each type product listed in this section.
3. Provide data substantiating that products being proposed for this project comply with the requirements stated herein. Provide detailed explanation of the differences of proposed products and the specified products.
4. Manufacturer shall provide evidence of a written Quality Control System.
5. Installation will be performed by a Certified Detention Equipment Contractor.

1.5 PRODUCT HANDLING

- A. Package each item of hardware separately in containers, complete with necessary fasteners, installation instructions and installation templates. Mark each container with item numbers, location of installation in accordance with corresponding information shown on final hardware schedule.
- B. Store products at site to prevent damage or loss until installation is made.
- C. Deliver all keys in one shipment by secure carrier (hand carrier or registered mail) from manufacturer directly to authorized representative of the Owner, as directed by the Architect-Engineer.

1.6 WARRANTY

Comply with requirements of Division 11 Section 11 19 00 "Basic Detention Equipment Requirements."

1.7 MAINTENANCE

- A. Provide spares in the quantities listed below for each hardware type:
 - 1. Locks: Two of each type used (one left hand, one right hand).
 - 2. Escutcheon: Two of each type used.
 - 3. Cylinder Shield: Two of each type used.
 - 4. Hinges: Six of each type used.
 - 5. Door Position Switch (DPS): Two of each type used (one of each hand, if applicable).
 - 6. Closer: Two of each type used (one of each hand, if applicable).
 - 7. Pulls:
 - a. Raised Pull: Two of each type used
 - b. Flush Pull: Two of each type used
 - 8. Wall Bumper: Twelve of each type used
 - 9. Weather Threshold: Two sets, 4' lengths.
 - 10. Pass-Resistant Threshold: Two sets, 4' lengths.
 - 11. Weatherstripping/Smoke Gasketing: Two sets
 - 12. Jamb Switch (Keeper Switch): Two of each type used.
 - 13. Food Pass hardware: Two food pass door sets complete with all hardware:
 - a. 1 ea – Lock
 - b. 2 ea – Hinges

- c. 1 ea - Pass door with integral pull

14. Kickplate:

- a. 10" x (door width less 2") x 14 gage stainless steel, US32D finish, with security screws. Provide two.
- b. 34" x (door width less 2") x 14 gage stainless steel, US32D finish, with security screws. Provide two (per key quantities schedule only).

B. Locking Device Spare Parts

Provide six complete sets of switches, wheels and motor assemblies.

C. Fasteners and Accessories:

Furnish five percent extra fasteners and other miscellaneous accessories required for installation.

D. Furnish, for institution use only, two complete sets of:

- 1. Special tools required for locking device and hardware maintenance
- 2. Lock repair kits for each type of lock

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer shall submit to the Architect upon request, twenty-one (21) days prior to bid date, their qualifications as required by Section 1.04.
 - 1. Southern Folger

2.2 MECHANICAL DETENTION HARDWARE AND LOCKING DEVICES

- A. Mechanical lever tumbler locks:
General: Lever tumbler locks shall operate with paracentric key. Key all lever tumbler locks into one keying system. Key locks alike in groups or key differently to approved keying schedule. Master keying is not an option for lever tumbler locks. Include lock mounting, escutcheons, strike and mounting screws for complete application. Use Torx tamper resistant screws on cylinder escutcheons, lock mounting and strike.
- B. Maximum security dead latch:
 - 1. Product/Model#:
 - a. Folger Adam #70 Series
 - b. Southern Steel 1070A
 - 2. Material:
 - a. Case: Ductile iron case or formed steel case and cover
 - b. Cover: Cold rolled steel, 3/8 inch thick. For ductile iron case
 - c. Latch bolt: Cold rolled steel, electro-galvanized, 3/4 inch thick with two 1/4 inch diameter hardened steel roller pins, 3/4 inch throw.

- d. Deadlock actuator: Cold rolled steel, electro-galvanized, 1/2 inch thick, 1/2 inch travel
 - e. Cylinder: Investment cast, silicon brass alloy, for key one side or key both sides.
3. Performance:
- a. Lock shall comply with UL10B Fire Tests of Door Assemblies; Class A - 3 hour rating.
 - b. Key unlocks and retracts latch bolt. Deadlocked by actuator when closed. Key removable in latched and deadlocked position.
4. Accessories:
- a. Lock mountings: G for grille doors, HM for hollow metal doors and P for plate doors.
 - b. Strike: 3/16 inch steel with dust box to protect bolt.
 - c. Strike: 3/16 inch steel with dust box and switch to monitor latch bolt position.

2.3 CYLINDERS, KEYS AND KEYING

- A. The security locks will incorporate three (3) separate keying systems: one for pin tumbler (mogul cylinder) one for lever tumbler (paracentric) and one for commercial cylinder locks. Each keying system's keys shall be die stamped for identification corresponding to the hardware supplier's final schematic keying chart.
- B. Mogul cylinder locks shall be master keyed as directed. Provide cut change keys, and master keys as required.
- C. For all individual key designations, to each required individual Key Cabinet, there shall be two (2) keys provided. For each master key designation, there shall be three (2) keys for each required individual key cabinet.
- D. A complete, detailed schematic chart of the keying system will be required. The hardware supplier will also be required to enter the key symbols for all doors on additional floor plans that will be supplied by the Architect. Two (2) copies of the schematic keying chart and architectural floor plans shall be turned over to the user at the completion of the project. The cost for this service shall be included with the cost of materials at the time of bidding.

2.4 SCREWS, FASTENERS AND TOOLS

- A. Furnish exposed fasteners to match item fastened. Make fastener of the same metal as item fastened, except use plated brass or stainless steel for all aluminum items. Provide twenty (20) spares of each type of fastener used for anchoring hardware.
- B. Provide security-head (star design with center pin) security fasteners for exposed fasteners on all detention hardware, regardless of manufacturer. Furnish six (6) tool holders and six (6) bits for each different size screw. Holders and bits shall be left at project after installation and become property of the user.

2.5 ACCESSORIES

A. Mortised institutional hinge:

1. Product/Model#:
 - a. Southern Folger 204FMSS/4-1/2FM-KS
2. Material/Description
 - a. Full mortised, 0.188 inch thick investment-cast stainless steel leaves.
 - b. Two reinforced polymer bearings with lubricant designed specifically for stainless steel pin. Assembly to exhibit low coefficient of friction.
 - c. Stainless steel hinge pin, non-removable and fully concealed.
 - d. Provide quantities as follows:
 - (1) Doors less than 5 ft high - 1 pair
 - (2) Doors over 5 ft to 7 ft 6 in - 1-1/2 pair
 - (3) Doors over 7 ft 6 in to 10 ft - 2 pair
 - (4) Doors over 3 ft 8 in wide - 2 pair

B. Knob door pull

1. Product/Model#:
 - a. Southern Folger 215C
2. Material/Description
 - a. Material: Brass.
 - b. Finish: US26D

2.6 FINISHES

	<u>U/S SYMBOL</u>	<u>ANSI SYMBOL</u>	<u>DESCRIPTION</u>
Hinges, Exterior	US32D	630	Satin Stnls Stl
Hinges, Interior	US26D	626	Satin Chrome
Locks & Pulls	US26D	626	Satin Chrome
Closers	AL	689	Aluminum Painted
Push, Kick	US32D	630	Satin Stnls Stl
Stops	US26D	626	Satin Chrome

2.7 KEY CABINET

- A. Key control shall be furnished with a capacity of 1.75 times the number of individual key designations.
- B. Cabinets shall have concealed-type hinge and rounded sides.
- C. Panels must have individual hook and label pockets formed as an integral part of the panel, for mogul key types, as required.

- D. Keys shall not leave the manufacturer's custody without prior arrangements for delivery and authorization from the Owner.

2.8 SECURITY SPARE LOCKS AND LOCK PARTS

- A. Shall be provided for the Owners' stock as follows:
- B. One complete set of security screwdrivers for all sizes of security screws used on this project.
- C. One repair parts list and assembly drawings bound in a manual for all security products supplied in this section.

2.9 DOOR AND HARDWARE SCHEDULE

- A. The hardware group/sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper sizes, quantities, weights, gage and function as required by these specifications and as recommended by manufacturers involved.

HARDWARE SET # DH-1

For Each Door:

3 ea	204FMSS	4 ½ x 4 ½ Mortised Hinge
1 ea	1070A-2	Mechanical Combination Spring and Deadlock
2 ea	215C	Knob Pull
1 ea	2210	Concealed closer
1 ea	420	Detention Door Stop
3 ea	307D	Door Silencer

PART 3 – EXECUTION:

3.1 GENERAL

Comply with requirements of Division 11 Section "Basic Detention Equipment Requirements".

3.2 INSTALLATION

- A. Comply with requirements of Division 11 Section "Basic Detention Equipment Requirements".
- B. All shipping of detention equipment hardware and coordination with other detention equipment shall be the responsibility of the Detention Equipment Supplier.

3.3 FIELD QUALITY CONTROL

Comply with requirements of Section "Basic Detention Equipment Requirements."

3.4 ADJUSTMENT AND REPAIRING

Comply with requirements of Section "Basic Detention Equipment Requirements."

3.5 PROTECTION AND CLEANING

Comply with requirements of Section, "Basic Detention Equipment Requirements."

END OF SECTION 087810

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Glass and glazing.

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): Local ambient conditions.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For each glass type and color indicated, in the form of 300-mm- square Samples for glass and of 12" long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thickness for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- 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. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- G. Product Test Reports: From a qualified testing agency indicating specified products comply with requirements indicated, based on comprehensive testing.
- H. SWRI Validation Certificate: For each elastomeric glazing sealant specified to be validated by SWRI's Sealant Validation Program.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.
- D. Source Limitations for Tinted Glass: Obtain tinted, heat-absorbing, and light-reducing float glass from one primary-glass manufacturer for each tint color indicated.

- E. Source Limitations for Laminated Glass: Obtain laminated-glass units from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- F. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- G. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Glass Testing Agency Qualifications: An independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- H. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 - 3. Test elastomeric glazing sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- I. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glass type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants.
 - 1. Use manufacturer's standard test methods to determine whether priming and other specific preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - a. Perform tests under normal environmental conditions replicating those that will exist during installation.
 - 2. Submit not fewer than nine pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, and insulating units) as well as one sample of each glazing accessory (gaskets, tape sealants, setting blocks, and spacers).
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.
 - J. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - K. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
 - L. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 - M. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines," and SIGMA TB-3001, "Sloped Glazing Guidelines."
 - N. Preinstallation Conference: Conduct conference at Project site.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- 1.7 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 liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4 degrees C.

1.8 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.
- B. Manufacturer's Special Warranty on Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

- 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. AFG Industries Inc.; Krystal Klear.
 - 2. Pilkington Building Products North America; Optiwhite.
 - 3. PPG Industries, Inc.; Starphire.
 - 4. SAFTIFIRST, Super Secure II- XLS-120 min.

2.2 GLASS TYPES

- A. General:
 - 1. 2 hr. Fire-rated detention Safety Glass for (218-4) Prisoner Door-Ballistic Level III
 - 2. Laminated Safety Glass for interior storefronts and windows. ¼" min.

2.3 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact.
 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. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range for this characteristic.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
1. Additional Movement Capability: Where additional movement capability is specified in the Glazing Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.

2.4 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 A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.5 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.
- C. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thickness, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate 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 the length plus width is larger than 50" as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8" 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. 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.
- K. 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 SEALANT GLAZING (WET)

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

3.5 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 088000

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SECTION 092216

NON-STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.
 - 3. Security Mesh for stud walls in "File Secured Storage Rm. 109".

- B. Related Requirements:

- 1. Division 5 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

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

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized unless otherwise indicated.
- C. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch or as indicated on drawings.
 - b. Depth: As indicated on Drawings
 - 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch or as indicated on drawings.
 - b. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; Slotted Deflecto Track.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
- E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-

rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 0.033 inch
- G. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.033 inch.
 2. Depth: As indicated on Drawings.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
 1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
 1. Depth: 3/4 inch.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch- diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, chemical anchor
2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch wide flanges.

1. Depth: 2-1/2 inches.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.033 inch.
 - b. Depth: 1-5/8 inches.
3. Dimpled Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.025 inch.
 - b. Depth: 1-5/8 inches.
4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.033 inch.
5. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

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

- a. Armstrong World Industries, Inc.; Drywall Grid Systems.
- b. Chicago Metallic Corporation; Drywall Grid System.
- c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. 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.

2.5 SECURITY MESH

- A. Provide Security Mesh- attach to metal studs floor to structure above mesh to be attached to studs as recommended by manufacturer.
 - 1. Manufacturers:
 - a. McNichols CO.
 - b. Clark Dietrich Building Systems
 - c. Amico, A Gibraltar Industries Company
- B. Mesh: $\frac{3}{4}$ #9, Carbon Steel, flattened, expanded, 10 ga.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to

building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

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

C. Install bracing at terminations in assemblies.

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

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Furring Members:
 - 1. Erect insulation, specified in Division 7 Section "Building Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900**GYPSUM BOARD****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.
 - 2. Exterior gypsum board for ceilings and soffits.
 - 3. Tile backing panels.
 - 4. Texture finishes.

- B. Related Requirements:

- 1. Division 6 Section "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Division 9 Section "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board panels.
 - 3. Division 9 Section "Gypsum Board Shaft-Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.

1.3 ACTION SUBMITTALS

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

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
 - 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 3. Simulate finished lighting conditions for review of mockups.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 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.
1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products".
 2. Fire Resistance Rated and Smoke Rated Assemblies: In accordance with the Florida Building Code and Florida Fire Prevention Code.
 - a. All fire and smoke rated assemblies shall have comprehensive labeling of face sheets in all above ceiling and concealed areas.
- C. Sound Rated Assembly Characteristics: For gypsum board assemblies with sound ratings provide material and construction identical to those tested in assembly indicated according to Underwriter's Laboratory or other recognized testing authority and in accordance with USGA publication GA-600 "Select" construction for sound rated assemblies.
- D. Finish Work shall be subject to inspection using a lighting level of not less than 50 foot candles at the surface of the gypsum board. Surfaces judged to be unsuitable for finishing, or after finishes have been applied, will be rejected and repaired.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- 1.6 FIELD CONDITIONS
- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 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. Regional Materials: Gypsum panel products shall be manufactured within 500 miles of Project site.
- D. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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

2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. Temple-Inland.
7. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

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

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

E. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: As indicated.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Sheathing.
 - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond, e(2)XP.
 - d. USG Corporation; Securock Glass Mat Sheathing.
 2. Core: 5/8 inch, Type X.

2.6 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 2. Core: 5/8 inch, Type X.
 3. Mold Resistance: ASTM D 3273, score of 10.

2.7 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Exterior Trim: ASTM C 1047.
1. Material: plastic
 2. Shapes:

- a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 - 3. Finish: As selected from manufacturers standard selections.

2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, 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, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.9 AUXILIARY MATERIALS

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

- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

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

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - d. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

- F. Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally).
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Flexible Type: Apply in double layer at curved assemblies.
 - 4. Ceiling Type: Drywall ceiling and soffits.
 - 5. Abuse-Resistant Type: Corridor walls, lobbies, MPR, Activity Room, Classrooms, Mail Room and Fitness Room to 8'-0" AFF.
 - 6. Moisture- and Mold-Resistant Type: As indicated on Drawings.
 - 7. Glass-Mat Interior Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. U-Bead: Use at exposed panel edges.
 - 5. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
 - 4. Level 5: Ground floor Courtroom and associated areas, Public Records / Juvenile and associated spaces.

- a. Primer and its application to surfaces are specified in other Division 9 Sections.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.8 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.9 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013**CERAMIC TILING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Glazed wall tile.
 - 2. Glazed floor tile.
 - 3. Stone thresholds installed as part of tile installations.

1.3 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
- B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
 - 1. Moderate: Passes cycles 1 through 10; Support areas.
 - 2. Light: Passes cycles 1 through 6; Toilets and Bathrooms.

1.5 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Shop Drawings: For the following:
 - 1. Tile patterns and locations.

2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.
1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
 2. Full-size units of each type of trim and accessory for each color required.
 3. Stone thresholds in 6-inch lengths.
- D. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.
- F. Tile Test Reports: Indicate and interpret test results for compliance of special-purpose tile with specified requirements.
- G. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
1. Stone thresholds.
 2. Waterproofing.
- E. Mockups: Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate

aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.

1. Locate mockups in the location as directed by Architect.
2. Notify Architect 7 days in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before proceeding with final unit of Work.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 1/2 of 1 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's: This specification is based on products and the system of the following manufacturer:

1. Glazed Wall Tile:
 - a. Refer to drawings for manufacturer, color and series as basis for design.
 - b. No other system will be acceptable.
2. Porcelain Floor Tile:
 - a. Refer to drawings for manufacturer, color and series as basis for design.
 - b. No other system will be acceptable.
3. Mortars and Grout:
 - a. As manufactured by W.R. Bonsal Company.
 - b. Other acceptable systems include the following approved manufacturer's:
 1. "Hydroment" systems as manufactured by Bostik.
 2. Custom Building Products.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Glazed Wall Tile: Provide flat tile complying with the following requirements:
 - 1. Module Size: Refer to drawings.
 - 2. Thickness: 5/16 inch.
 - 3. Face: Plain with cushion edges.
 - 4. Mounting: Factory back-mounted.
- B. Porcelain Floor Tile: Provide flat tile complying with the following requirements:
 - 1. Module Size: Refer to drawings.
 - 2. Thickness: 5/16 inch.
 - 3. Face: Plain with cushion edges.
 - 4. Mounting: Factory back-mounted.
- C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
 - 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 - 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. Base for Thin-Set Mortar Installations: Sanitary.
 - b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
 - c. External Corners for Thin-Set Mortar Installations: Surface bullnose.
 - d. Internal Corners: Sanitary corners.

2.4 STONE THRESHOLDS

- A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
 - 1. Fabricate thresholds to heights indicated, but not more than 1/2 inch above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.
- B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241.
 - 1. Provide white, honed marble complying with the Marble Institute of America's Group A requirements for soundness, unless a different material is specified in the Architectural Finish drawings; 2-1/2-inches in width.

2.5 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

- A. General: Provide products that comply with ANSI A118.10 and the descriptions in this Article.
- B. Acrylic-Latex Waterproofing: Manufacturer's standard proprietary product consisting of one-part acrylic-latex additive and flexible cementitious fiber mortar, factory packaged for job-mixing and trowel application.

C. Products:

1. "PRP 315" as manufactured by Mapei Corporation.
2. Alternate manufacturers and systems will be reviewed as a substitution, under the guidelines of Section 012300 of these specifications.

2.6 SETTING MATERIALS

A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1A and as specified below:

1. Reinforcing Wire Fabric: Galvanized, welded wire fabric, complying with ASTM A 185 and ASTM A 82, except for minimum wire size.
2. Expanded Metal Lath: Provide diamond-mesh lath complying with ASTM C 847. for requirements indicated below:
3. Latex additive (water emulsion) serving as replacement for all of gaging water, of type specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.

B. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.
 - a. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

C. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:

- a. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive.

D. Water-Cleanable, Tile-Setting Epoxy Adhesive: ANSI A118.3.

E. Modified-Epoxy Emulsion Mortar: ANSI A118.8.

2.7 GROUTING MATERIALS

A. Chemical-Resistant Epoxy Grout: ANSI A118.3, color as indicated.

1. Provide product capable of resisting continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, as certified by mortar manufacturer for intended use.

2.8 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. Chemical-Resistant Sealants: For chemical-resistant floors, provide sealants compatible with chemical-resistant mortars and grouts, approved for use indicated by manufacturers of both mortar/grout and sealant and with chemical-resistance properties equivalent to mortar/grout.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
 - 2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
 - 1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- B. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "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." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the 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.
 - 1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

- H. Grout tile to comply with the requirements of the following tile installation standards:
 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.
- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
 1. Flood test for minimum of 24-hours.

3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.
- B. Joint Widths: Install tile on floors with the following joint widths:
 1. Glazed Floor Tile: 3/16 inch.
- C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 1. Tile floors in wet areas, including showers, tub enclosures and laundries.
 2. Tile floors installed with chemical-resistant mortars and grouts.
 3. Tile floors composed of rib-backed tiles.
- D. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
 1. Wall Tile: 3/16 inch.

- C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 - 1. Tile wall installations in wet areas, including showers, tub enclosures and laundries.
 - 2. Tile installed with chemical-resistant mortars and grouts.

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 093013

SECTION 096513

RESILIENT 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.
- B. Related Sections:
 - 1. Division 9 Section "Resilient Floor Tile".

1.3 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.
- D. Product Schedule: For resilient products. Use same designations indicated on drawings.

1.4 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.

1.5 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 (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 90 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 90 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. 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.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, refer to the Finish Schedule in the drawings for selected manufacturer as basis of design. Other available manufacturers offering products that may be incorporated into the Work include the following:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - d. Flexco, Inc.
 - e. Johnsonite.
 - f. Mondo Rubber International, Inc.

- g. Musson, R. C. Rubber Co.
- h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
- i. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

- 1. Material Requirement: Type TV (vinyl, thermoplastic).
- 2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).
- 3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch.

D. Height: As indicated on Drawings.

E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: Match Architect's sample listed in the Finish Schedule.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.

B. Description: Carpet edge for glue-down applications, Nosing for carpet, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet and Transition strips.

C. Material: Vinyl.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

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 Stair Treads and 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.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum allowable relative humidity level measurement per manufacturer requirements.
- 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. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 2. Inside Corners: Use straight pieces of maximum lengths possible.

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 at edges of carpet and resilient floor covering that would otherwise be exposed.

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. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coat(s).
- E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519

RESILIENT TILE FLOORING

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: Resilient vinyl tile flooring.
- B. Related Sections: Sections related to this section include:
 - 1. General Requirements: Division 01 Specification Sections.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 302.1 Guide for Concrete Floor and Slab Construction.
 - 2. ACI SP-15 Field Reference Manual - Standard Specifications for Structural Concrete.
- B. ASTM International:
 - 1. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - 2. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - 3. ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 4. ASTM E1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - 5. ASTM E1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

6. ASTM F137 Standard Test Method for Flexibility of Resilient Flooring Materials with Cylindrical Mandrel Apparatus.
 7. ASTM F386 Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces.
 8. ASTM F536 Test Method for Size of Resilient Floor Coverings.
 9. ASTM F540 Test Method for Squareness of Resilient Floor Tile by Dial Gage Method.
 10. ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 11. ASTM F925 Standard Test Method for Resistance to Chemicals of Resilient Flooring.
 12. ASTM F970 Standard Test Method for Static Load Limit.
 13. ASTM F1482 Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring.
 14. ASTM F1514 Standard Test Method for Measuring Heat Stability of Resilient Vinyl Flooring by Color Change.
 15. ASTM F1515 Standard Test Method for Measuring Light Stability of Resilient Vinyl Flooring by Color Change.
 16. ASTM F1700 Standard Specification for Solid Vinyl Floor Tile.
 17. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 18. ASTM F1914 Standard Test Method for Short-Term Indentation and Residual Indentation of Resilient Floor Covering.
 19. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- C. Americans with Disabilities Act (ADA) of 1990.
- D. International Organization for Standardization (ISO):
1. ISO 9001 Quality Systems - Model Quality Assurance in Production, Installation, and Servicing.
 2. ISO 14001 Environmental Management Systems - Specification with Guidance for Use.

E. National Fire Protection Association (NFPA):

1. NFPA 253 Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.
2. NFPA 258 Recommended Practice for Determining Smoke Generation of Solid Materials.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:

1. The manufacturer of the flooring product must be accredited to both ISO 9001 (Quality Management System) and ISO 14001 (Environmental Management System).
2. Provide resilient tile flooring which has been manufactured and can be installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.5 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedure Section(s).
- B. Product Data: Submit product data, including manufacturer's technical specifications, for each type of specified products.
- C. Shop Drawings: Submit shop drawings showing layout, pattern and colors.
- D. Samples: Submit selection and verification samples for finish and colors.
- E. Quality Assurance/Control Submittals: Submit the following:
1. Test Reports: Upon request, submit test reports of physical performance and characteristics from recognized test laboratories.
 2. Technical Specifications: Submit manufacturer's technical specification document that certifies products meet or exceed specified requirements.
 3. Manufacturer's Instructions: Submit manufacturer's installation instructions for resilient flooring.
- F. Closeout Submittals: Submit the following:
1. Maintenance Data: Maintenance data for installed products in accordance with Division 01 Closeout Submittals, Maintenance Data and Operation Data Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

2. Warranty: Submit warranty documents specified herein.

1.6 QUALITY ASSURANCE

- A. Manufacturer: The manufacturer of the flooring product must be accredited to both ISO 9001 (Quality Management System) and ISO 14001 (Environmental Management System).
- B. Flooring Contractor Qualifications:
 1. The awarded contractor shall be an established firm with experience in the installation of the specified product and have access to all manufacturers' required technical, maintenance, specifications and related documents.
 2. The flooring contractor shall have completed at least 3 projects of similar scope, material and complexity, and must provide project reference details including contact names and telephone numbers
- C. Installer Qualifications: An experienced installer, as determined by contractor, who has specialized in the installation of work similar to that required for this project is to perform the work of this section.
 1. Installation procedures should be in strict accordance with Amtico International published technical documentation and shall not begin until the work of all other trades has been completed.
- D. Test Floors: Install test floor at project site using acceptable products and manufacturer approved installation methods.
Obtain Owner's and Architect's acceptance of maintainability and workmanship standard. Comply with Division 01 Quality Control (Test Floor Requirements) Section.
 1. Test Floor Size: Approximately 4' x 4'.
 2. Maintenance: Maintain test floor during construction for workmanship comparison; remove and legally dispose of test floor when no longer required.
 3. Incorporation: Test floor may be incorporated into final construction upon Owner's approval.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Division 01 Product Requirements Section.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- D. Storage and Protection: Store materials flat, protected from exposure to harmful weather conditions, between 50 degrees F - 81 degrees F (10 - 27 degrees C) and 50% (\pm 10%) relative humidity.

1.8 PROJECT CONDITIONS

- A. Substrate Conditions: Use the current test methods described below to determine the dryness as required to ensure initial and long-term success.
 - 1. Comply with ASTM F1869 testing procedures.
 - 2. Comply with ASTM F2170 testing procedures.
 - 3. The General Contractor shall be responsible for conducting in situ relative humidity testing (ASTM F2170) or calcium chloride testing (ASTM F1869). Perform minimum of 3 tests for the first 1000 square feet, and at least one test for each additional 1000 square feet, to ensure concrete internal relative humidity does not exceed 80% or moisture vapor emissions do not exceed 5.0 lb per 1000 square feet within a 24 hour period.
 - 4. Contingency for High Moisture Readings: If at the time of testing the moisture readings are in excess of 80% internal relative humidity or 5.0 lb moisture vapor emissions, the Architect will initiate testing using petrographic analysis to determine the Water/Cement Ratio and if sufficient hydration has taken place. If the Specifications were not followed in their entirety, water/cement ratio (as specified), and/or the concrete surface has been inadequately hydrated, the Contractor responsible for the placement of the cement shall be responsible for the costs associated with the petrographic analysis and subsequent remediation requirements.
- B. The Flooring Contractor shall verify in writing to the Owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 - 1. Moisture: Maximum of 80% internal relative humidity tested in accordance with the current ASTM F2170 or maximum of 5.0 lb Moisture Vapor Emission Rate tested in accordance with the current ASTM F1869.
 - 2. Alkalinity (ASTM F710): Between 7.0 - 10.0 Ph.
 - 3. Suitability of Substrate Surface: Ensure that substrate surface is sound, smooth and flat to 1/8 inch in 10 feet (3.2 mm in 3.1 m).
 - 4. For substrate conditions that require additional preparation, Flooring Contractor shall furnish Owner and General Contractor with written documentation detailing noncompliance, proposed remediation, timing and cost.
- C. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations. Areas to receive flooring shall be clean, fully enclosed, weathertight with stable environmental conditions between 64 degrees F - 81 degrees F (18 - 27

degrees C) and 50% (\pm 10%) relative humidity. The flooring material shall be conditioned in the same manner.

- D. Temperature Requirements: Maintain air temperature and relative humidity levels in spaces where products will be installed for time period before, during and after installation as recommended by manufacturer.
 - 1. Temperature Conditions: Maintain 64 degrees F - 81 degrees F (18 - 27 degrees C) for 48 hours before, during and continuously after installation.
 - 2. Relative Humidity Conditions: Maintain 50% (\pm 10%) relative humidity for 48 hours before, during and continuously after installation.
- E. Close spaces to traffic during resilient flooring installation and for time period after installation recommended in writing by the manufacturer.
 - 1. No foot traffic for 24 hours after installation
 - 2. No point loads for 48 hours after installation.
 - 3. Wait 48 hours after installation before any wet maintenance is performed.
- F. Install resilient flooring material and accessories after all other finishing operations, including painting, have been completed.

1.9 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit manufacturer's Commercial Limited Wear Warranty for Owner's acceptance. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.
 - 1. Warranty Period: Twenty years commencing on Date of Substantial Completion.
 - 2. Warranty Acceptance: Owner is sole authority who will determine acceptability of manufacturer's warranty documents.

1.10 MAINTENANCE

- A. Extra Materials: Deliver extra materials from same production run as products installed to Owner. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals (Maintenance Materials) Section.
 - 1. Quantity: Furnish quantity of full-size units equal to 5% of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

PART 2 - PRODUCTS

2.1 RESILIENT TILE FLOORING

A. Manufacturer:

1. Amtico International Inc. (800) 268-4260
2. Armstrong Flooring (888) 276-7876
3. Shaw Floors (800) 441-7429

B. Luxury Solid Vinyl Tile:

1. Product Testing (Minimum): Provide manufacturer's products which have been tested to meet the following minimum test standards.
 - a. Comply with ASTM F1700

C. Installation Adhesive: As recommended by Manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data for substrate condition, preparation and installation, including product technical bulletins, product catalog installation instructions and product packaging instructions for installation. Flooring contractor must examine areas and conditions under which resilient flooring and accessories are to be installed and must notify General Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner and Architect.

3.2 EXAMINATION

- A. Substrates: Examine and verify that all substrates, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 PREPARATION

A. Surface Preparation:

1. Concrete subfloors are existing and shall be examined and prepared to receive new flooring material.
2. Floors must be clean, dry and smooth.

3. Maintain room temperature, adhesive and flooring material at 64 degrees F - 81 degrees F (18 - 27 degrees C) and 50% ($\pm 10\%$) relative humidity for 48 hours before, during and continuously after installation.
4. Broom clean or vacuum surfaces to be covered and inspect substrate. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.
5. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
6. Substrate Cleaning and Preparation: Comply with manufacturer's requirements for substrate cleaning and preparation for resilient flooring products.
7. Leveling and Patching: Use only Portland cement based leveling and patching compounds, in accordance with compound manufacturer's requirements, to fill depressions, holes and cracks and to smooth substrate surface to 1/8 inch (3.2 mm) in a 10 foot (3.1 m) radius to receive resilient flooring.

3.4 INSTALLATION

- A. Resilient Tile Installation: Install tiles from established center marks so that tiles at opposite room edge are of equal tile width. Follow installation procedures in accordance with Amtico International published Technical Manual, and do not begin until the work of all other trades has been completed.
 1. Patterns: Install tiles in patterns indicated on drawings.
 2. Rolling: Roll floor using 100 lb roller in both directions within 1 hour.
- B. Adhesive: Apply adhesive to substrate in accordance with manufacturer's instructions, including trowel notching, adhesive mixing and adhesive open and working times.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.
 1. Site Visits: Two (2).

3.6 CLEANING AND PROTECTION

- A. Initial Cleaning: Remove temporary coverings and protection of adjacent work areas. When installation has been finished for 24 hours, inspect workmanship and repair or

replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

1. Pick up litter and sweep floor to remove debris using a non-treated dust mop or vacuum cleaner with hard surface attachment.
- B. Initial Wet Cleaning: Wait at least 48 hours after installation is complete before performing the initial wet cleaning process. This will allow the adhesive to cure.
1. Clean new floor thoroughly using a proprietary cleaner/maintainer solution of neutral pH detergent diluted in accordance with manufacturer's instructions. Machine scrub the wet floor using a 3M Red scrubbing pad or equivalent. When finished, remove remaining cleaning solution using a mop or wet vacuum. Rinse floor with clean water and allow to dry thoroughly.
 2. In conditions of heavy soiling, pre-wash the floor using a proprietary cleaner solution of neutral pH detergent mixed in accordance with manufacturer's instructions. Allow the solution to stand for 5 - 10 minutes before machine scrubbing or in accordance with the manufacturer's instructions.
 3. For floors requiring the application of a floor finish, initial cleaning should be carried out using a suitable floor stripper.
 4. When floor finishes are used, Amtico International recommends at least 2 coats of a satin or low gloss floor finish be applied in accordance with the manufacturer's instructions. Products used should be suitable for the intended usage.
- C. Routine Maintenance: Frequency of mop or machine cleaning should be determined based upon daily usage and soiling conditions. Perform routine maintenance in accordance with the Amtico International Maintenance Procedures.
- D. Protection: Protect installed product's finish surfaces from damage during construction. After the floor has been installed, it should be maintained in a manner that provides a clean and slip resistant surface for occupant safety.

3.7 SCHEDULES

- A. Schedules: Refer to Finish Schedule for location of resilient tile flooring.

END OF SECTION 096519

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SECTION 096813**TILE CARPETING****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 modular, carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile if applicable.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.

4. Type of installation.
 5. Pattern of installation.
 6. Pattern type, location, and direction.
 7. Pile direction.
 8. Type, color, and location of insets and borders.
 9. Type, color, and location of edge, transition, and other accessory strips.
 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in the Interior Finish Drawings:
- B. Color: Match Architect's samples
- C. Pattern: Match Architect's samples
- D. Fiber Content: eco solution q nylon
- E. Fiber Type: Match Architect's samples
- F. Pile Characteristic: Level-loop or Multi-level pattern loop.
- G. Dye Method: 100% solution dyed
- H. Density: 24 oz./cu. yd.
- I. Pile Thickness: 0.127' for finished carpet tile according to ASTM D 6859.
- J. Stitches: 11 stitches per inch.
- K. Gage: 1/12
- L. Backing System: ecoworx tile
- M. Size: As indicated on drawings
- N. Applied Soil-Resistance Treatment: Manufacturer's standard treatment
- O. Antimicrobial Treatment: Manufacturer's standard material
- P. Performance Characteristics: As follows:
 - 1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
 - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm
 - 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
 - 4. Tuft Bind: Not less than 6.2 lbf (28 N) according to ASTM D 1335.
 - 5. Delamination: Not less than 3.5 lbf/in. (15 N/mm) according to ASTM D 3936.
 - 6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 - 7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 - 8. Resistance to Insects: Comply with AATCC 24.
 - 9. Noise Reduction Coefficient (NRC): according to ASTM C 423.
 - 10. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.

11. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
12. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
13. Electrostatic Propensity: Less than 2 kV according to AATCC 134.
14. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
15. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 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).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete floors: 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.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8-inch-wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

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

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 099123

INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Aluminum (not anodized or otherwise coated).
 - 6. Wood.
 - 7. Gypsum board.
 - 8. Plaster.
 - 9. Spray-textured ceilings.
- B. Related Requirements:
 - 1. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location 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.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 1. Product name and type (description).
 2. Batch date.
 3. Color number.
 4. VOC content.
 5. Environmental handling requirements.
 6. Surface preparation requirements.
 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:
1. Benjamin Moore & Co.
 2. Duron, Inc.
 3. Glidden Professional, Division of PPG Architectural Finishes, Inc.
 4. PPG Architectural Finishes, Inc.
 5. Pratt & Lambert.
- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Dry-Fog Coatings: 400 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.

- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors: Match Architect's samples.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 - 1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - e. Plaster: 12 percent.

2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 3. Plaster Substrates: Verify that plaster is fully cured.
 4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Uninsulated metal piping.

- b. Uninsulated plastic piping.
 - c. Metal conduit.
 - d. Plastic conduit.
 - e. Tanks that do not have factory-applied final finishes.
- 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
- 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #3: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #3: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell, (Gloss Level 3), MPI #151: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

B. Concrete Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Enamel System:

- a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
- b. Topcoat: Floor paint, latex, slip-resistant, low gloss, (maximum Gloss Level 3), MPI #60: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

C. CMU Substrates:

1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4 X-Green: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 4), MPI #43 X-Green: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

2. Water-Based Light Industrial Coating System:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4 X-Green: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss, (Gloss Level 5), MPI #153: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

D. Metal Substrates (Aluminum, Steel, Galvanized Steel):

1. Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
- b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
- c. Topcoat: Water-based acrylic, semi-gloss, (Gloss Level 5), MPI #147 X-Green: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

2. Water-Based Dry-Fall System:

- a. Top Coat: Dry-fall latex, flat, MPI #118: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
- b. Top Coat: Dry-fall latex, eggshell, MPI #131/155: S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-2 Series, at 6.0 mils wet, 1.9 mils dry.

3. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss, Gloss Level 5), MPI #153: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #39: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, gloss, (Gloss Level 5), MPI #54: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Acrylic/Alkyd System:

- a. Prime Coat: Primer sealer, latex, interior: S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils wet, 1.8 mils dry.
- b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
- c. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

F. Gypsum Board and Spray-Texture Ceiling Substrates:

1. Latex System:

- a. Prime Coat: Primer, latex, interior, MPI #149 X-Green: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53 X-Green/#143 X-Green: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat at ceilings.
- d. Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- e. Topcoat: Latex, interior, semi-gloss, (Gloss Level 4), MPI #43 X-Green: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

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SECTION 102800

TOILET, BATH AND LAUNDRY 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. Public-use washroom accessories.
 - 2. Underlavatory guards.
- B. Related Sections:
 - 1. Division 8 Section "Mirrors" for frameless mirrors at the bathrooms.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.
- D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

- E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for 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.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 1/4" thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 6. Tubular Specialties Manufacturing, Inc.
- B. Refer to the drawings for exact locations and quantities; general or specific location descriptions are provided for clarity
- C. Toilet Tissue (Jumbo-Roll) Dispenser:
 - 1. Basis-of-Design Product: Bobrick BOB2892, however coordinate with Owner to use campus standard
 - 2. Description: per model number provided.
 - 3. Mounting: Surface mounted.
 - 4. Capacity: per model number provided.
 - 5. Material and Finish: Stainless Steel
- D. Paper Towel Dispenser:
 - 1. Location and Quantity: One per private restroom (staff)
 - 2. Mounting: Semi recessed.
 - 3. Basis of Design Product: Bobrick BOB262, however coordinate with Owner to use campus standard
 - 4. Material and Finish: Stainless Steel.
 - 5. Lockset: Tumbler type.
- E. Waste Receptacle:
 - 1. Basis-of-Design Product: Bobrick, B-43644
 - 2. Location and Quantity: One per private restroom and one per common area of the public restroom
 - 3. Mounting: Open top, recessed.
 - 4. Minimum Capacity: 11.2 gallon.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 6. Lockset: Tumbler type for waste-receptacle.

- F. Liquid-Soap Dispenser:
 - 1. Location: Private restroom and HC stall
 - 2. Basis-of-Design Product: Bobrick Model B-5050
 - 3. Description: Designed for dispensing soap in liquid form.
 - 4. Mounting: Vertically oriented, surface mounted.
- G. Liquid-Soap Dispenser:
 - 1. Location: Public restrooms, one per countertop sink
 - 2. Basis-of-Design Product: Bobrick Model B-8263
 - 3. Description: Automatic, lavatory-mounted foam soap dispenser
 - 4. Mounting: Deck mounted on vanity.
- H. Grab Bar:
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 3. Outside Diameter: 1-1/2 inches.
 - 4. Configuration and Length: Straight, 36 inches long and Straight 42 inches long.
- I. Sanitary-Napkin Disposal Unit:
 - 1. Mounting: Partition mounted, dual access
 - 2. Mounting: Surface mounted at private restrooms and HC stalls.
 - 3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- J. Seat-Cover Dispenser:
 - 1. Basis-of-Design Product: Bobrick, B-4221.
 - 2. Mounting: Surface mounted.
 - 3. Minimum Capacity: 250 seat covers.
 - 4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 - 5. Lockset: Tumbler type.
- K. Shelf:
 - 1. Basis-of-Design Product: Bobrick, B-683.
 - 2. Location and Quantity: On wall behind and above the toilet
 - 3. Description: Hinged unit with spring-loaded shelf that automatically returns to vertical position.
 - 4. Nominal Size: 24 long by 5-3/4 inches.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- L. Mirror Unit:
 - 1. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.

- a. Corners: Welded and ground smooth.
 - 2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 - 3. Size: As indicated on Drawings.
 - 4. Location: Staff Restroom (private)
- M. Hand Sanitizer Dispenser:
- 1. Mounting: Surface mounted
 - 2. Location: One per the following locations; building lobby area, office area, break rooms, elevator lobby, fitness room, open and closed study lounge, and activity with exact locations as directed by the Owner
 - 3. Nominal Depth: less than 4" per ADA
 - 4. Material and Finish: Manufacturer standard

2.3 UNDERLAVATORY GUARDS

- 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. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
- B. Underlavatory Guard:
- 1. 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.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

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.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104410
FIRE PROTECTION
CABINETS AND EXTINGUISHERS

PART 1 GENERAL

1.01 WORK INCLUDES

- A. Extent of fire extinguisher and cabinet work is indicated on the Drawings and include, but is not limited to, the following:
 - 1. ABC-type portable fire extinguisher
 - 2. Fire extinguisher cabinets.
 - 3. Attachment hardware.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets and fire hose cabinets include rough-in dimensions and details showing mounting methods, relationship to surrounding construction, style and materials.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Larsen's Manufacturing Co.
 - 2. J.L. Industries.
 - 3. Potter-Roemer.
- B. Equivalent products of other manufactures may be proposed, but in no case should extinguisher have a plastic valve and handle assembly.

2.02 FIRE EXTINGUISHERS

- A. General: Provide fire extinguisher for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Project Consultant from manufacturer's standard.
- B. Abbreviations indicated below to identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

1. MP 10; Multi-purpose Dry Chemical type for class A, B, and C fires (4A-60B:C): Steel shell with polyester/export paint finish UL-rated, 10-pound nominal capacity, one (1) extinguisher per cabinet at common building areas
2. 10# CO2 at all mechanical, electrical rooms and computer lab.
3. MP 10; Multi-purpose Dry Chemical type for class A, B, and C fires (4A-60B:C): Steel shell with polyester/export paint finish UL-rated, 2 ½ pound nominal capacity, one (1) extinguisher at all Apartment Units to be located within the kitchen cabinet underneath the sink.
4. 20# Type K fire extinguisher at any public use kitchenette.

2.03 FIRE EXTINGUISHER AND VALVE CABINETS

- A. General: Provide fire extinguisher cabinets of suitable size for housing fire extinguishers of types and capacities required.
 1. Fire Extinguisher Cabinets: Larsen's fully recessed architectural series Model #FS2409 R2 with Full Glass with Larsen-Loc has been used as a basis of design for this Project.
 - a. Use cabinets that use maximum recess available for location.
 - b. Provide fire rated cabinet assemblies in fire rated partition assemblies.
- B. All fire extinguisher cabinets to be keyed alike
- C. Glass to be Tempered Safety Glass
- D. Construction: Manufacturer's standard 20-gauge steel box with white baked enamel finish; trim, frame, door and hardware to suit cabinet type. Weld all joints and grind smooth. Miter and weld perimeter door frames.
- E. Cabinet Type: Suitable for mounting conditions indicated for recessed type cabinet box (tub) recessed in fire-rated and non fire-rated walls with flush door.
- F. Door Material and Construction: Manufacturer's standard door construction coordinated with recessed cabinet type.
 1. Aluminum: Manufacturer's standard flush, one piece aluminum door construction with extruded or fabricated aluminum and all corners mitered. Clear satin anodized finish. Full tempered glass panel; tempered glass, 1/8 inch thick unless otherwise indicated.
 2. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either level handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180 degrees.

G. Dimensions: Provide cabinets with inside dimensions as follows:

1. Fire Extinguisher Cabinets: 24' H x 9" W x 5" D.

2.05 FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS

A. General: Comply with NAAMM "Metal Finishes Manual" for finishes designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering prior to shipment.

B. Finishes:

1. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale. Apply finish to all surfaces of fabricated and assembled units, whether exposed or concealed when installed, except those surfaces indicated to receive another finish.
2. Finish Color: Color to be selected from manufacturer's standard color pallet.
3. Doors: Clear anodized.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install items included in this section in locations and at heights to comply with applicable regulations.
- B. Prepare recesses in wall for fire extinguisher cabinets as required by type and size of cabinet and style of trim, and to comply with manufacturer's instructions.
- C. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
- D. All extinguishing equipment shall have annual maintenance performed and be certified according to requirements of NFPA 10 no more than one (1) month prior to occupancy.

3.02 IDENTIFICATION

- A. Identify all fire extinguisher with permanent marking (non-removable label, engraving, silk screen process) as follows:

PROPERTY OF INDIAN RIVER COUNTY COURTHOUSE. UNLAWFUL FOR
PERSONAL USE.

END OF SECTION 104410

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SECTION 106710

METAL STORAGE 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: System of modular, factory finished, steel uprights, shelves, and shelf supports which can be site assembled without clamps or special tools. Includes front base, back and center stops, shelf reinforcement, solid back closure panels, file dividers, sliding reference shelves, hinged door assemblies, sliding door assemblies, and other accessories and hardware required for a complete, functional storage unit.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 2. ASTM A1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 3. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

1.4 DESIGN REQUIREMENTS

- A. Metal storage system shall be designed to adequately support live loads calculated by manufacturer from Owner's stated storage requirements and specific Project conditions.
 - 1. Shelf minimum uniform load: 40 pounds per linear foot.
 - 2. Maximum shelf deflection: L/140.
- B. System shall consist of modular components which can be site assembled without special tools, clamps, and bolts and shall be capable of reconfiguration, relocation, and expansion by adding new components.

1.5 SUBMITTALS

- A. Provide in accordance with Section 01330 - Submittal Procedures.
 - 1. Product data for system including design data and load calculations.
 - 2. Schedule of shelving and accessories to be provided including quantities, sizes, finishes, and installation locations.
 - 3. Shop drawings: Indicate layout, elevations, dimensions, and fabrication and installation details.
 - 4. Samples: color samples for selection by Architect.
 - 5. Manufacturer's installation and maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Manufacturer qualifications: Storage system shall be provided by firm with 25 years minimum successful experience in the storage and information retrieval industry.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. TAB, 605 Fourth Street, Mayville, Wisconsin 53050
Phone: 800-827-3288
Website: www.tab.com
- B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 01630 - Product Substitution Procedures.

2.2 SHELVING SYSTEM

- A. Type: Modular, adjustable, steel shelving system consisting of uprights, shelves, and shelf supports; 4-Post L&T Shelving as fabricated by Datum and provided by TAB.
- B. System shall have clean appearance without sway braces, gussets, and exposed holes except for divider and center stop slots.
- C. Front and back shelf flanges shall be flush with uprights.
- D. Shelves shall be adjustable on increments of 1-1/2 inches.

2.3 MATERIAL

- A. Steel sheet:
 - 1. Cold rolled steel sheet complying with ASTM A1008.
 - 2. Hot rolled, pickled steel sheet complying with ASTM A1011.
- B. Components shall be free of dents, oil canning, and other imperfections.
- C. Edges shall be smooth without burrs. There shall be no exposed sharp edges.

2.4 COMPONENTS

- A. Uprights: Each upright shall consist of front and back posts joined together.
 - 1. Height: 88-1/4 inches
 - 2. Posts: Hollow sections fabricated from cold rolled [18 gauge] steel. Inner wall punched with keyhole slots to receive shelf supports. Space holes at 1-1/2 inches.
 - a. End posts: 1 inch wide L shape.
 - b. Intermediate posts: 2 inches wide hollow T shape.
 - 3. Closed uprights: Front and back posts joined with [24 gauge] [0.79 mm] full height steel sheet welded to posts.
 - a. Provide closure sheet with bottom stiffening flange.
 - b. Use closed uprights.
 - 4. Open uprights: Front and back posts joined with 18 gauge, 3 inches high steel spacer welded to posts.
 - a. Number of spacers:
 - 1) 64 inches maximum height uprights: 3.
 - 2) 76 to 88 inches high uprights less than 30 inches deep: 3.
 - 3) All other uprights: 4
 - b. Bottom spacer to have stiffening flange.
 - c. Use open uprights.

- B. Shelves: Formed from cold rolled steel sheet with 25/32 inch channel formation on all sides.
 - 1. Material thickness: 22 gauge.
 - 2. Width: 36 and 48 inches.
 - 3. Depth: 12 and 24 inches.
 - 4. Form return flange at 120 degrees to ease installation.
 - 5. Provide shelves with slots at 2 inches for engaging file dividers or punched with holes for bin dividers. Provide shelves 18 inches or deeper with punched holes for center stops.
- C. Shelf supports: Fabricated from hot rolled steel with ears and rivets for attachment in keyhole slots of uprights.
 - 1. Material thickness: 14 or 11 gauge. [Thickness as determined by manufacturer to accommodate design loads and seismic requirements.]
 - 2. Height: 11/16 inches. [As determined by manufacturer to accommodate design loads and seismic requirements.]
- D. Shelf reinforcement: For heavy loaded shelving, provide U-shaped, 13 gauge, hot rolled steel reinforcement designed to be fit over and be installed perpendicular to shelf supports. Size, location, and spacing as determined by manufacturer and indicated on approved shop drawings.

2.5 ACCESSORIES

- A. Back stops: Provide 18 gauge, 7/16 inch deep cold rolled steel channel stops along full backside of shelves. Fabricate with slots to receive file dividers and end rivets to engage upright posts.
- B. Center stops: Provide 18 gauge, 3 inches high cold rolled steel center stops for double entry filing from both sides of shelf. Fabricate with bottom flange, top box channel, slots to receive file dividers, and plastic plugs or bolts for attachment.
- C. File dividers: Provide removable, self-locking, flat, 20 gauge steel dividers with radiused corners. Bottom of divider shall have 2 embossed tabs to engage shelf slots and back edge retaining tab to stabilize divider against stops.
 - 1. Height: 8 inches.
 - 2. Depth: 8 or 11 inches.
- D. Sliding reference shelf: 18 gauge steel shelf with ball bearing extension slides to be attached to underside of shelf supports.
 - 1. Shelf extension: 9 inches.

2.5 FACTORY FINISH

- A. All steel parts shall receive factory applied finish capable of withstanding 250 hours salt spray tested in accordance with ASTM B117.
 - 1. Thoroughly clean steel parts in multi-stage washer followed by application of phosphate coating.
 - 2. Electrostatically apply commercial enamel.
- B. Color: As selected by Architect from manufacturer's standard full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not uncrate storage shelving until painting, [carpet,] and other finishes have been applied and touch-up has been completed. Protect [carpet] from soiling and damage.
- B. Assemble and install storage shelving in accordance with approved shop drawings and manufacturer's instructions. Install shelving components and accessories plumb, level, rigid, and accurately aligned.

3.2 INSTALLATION ON MOBILE CARRIAGES

- A. Install metal storage system as part of mobile storage system specified in Section 106720 - Mechanical Assist Mobile Storage System.
- B. Install after tracks and mobile carriages have been installed and tested.
- C. Attach shelving to carriages with vibration proof fasteners of size, type, and spacing recommended by manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Remove protective coverings. Clean metal surfaces using clean water and mild detergent. Do not use abrasive agent, steel wool, or harsh chemicals. Rinse with clean water.
- B. Adjust sliding shelves and [hinged] [sliding] door assemblies to function smoothly and correctly.
- C. Protect metal storage shelving from soiling or damage. Provide coverings as required to protect items from remaining construction operations.

END OF SECTION 106710

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SECTION 106720

MECHANICAL ASSIST STORAGE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes: System of wheeled carriages onto which are mounted storage units and which move on tracks through a mechanically assisted, hand crank mechanism. System consists of:
 - 1. Aluminum tracks with steel rails.
 - 2. Wheeled steel carriages.
 - 3. Manually operated, mechanically assisted, geared, hand crank and drive shaft mechanism for moving carriages.
 - 4. Particleboard and steel channel floor decking system installed between tracks.
 - 5. Ramp sections providing smooth transition from tracks and floor decking.
 - 6. Installation on carriages of storage units specified in Section 106710 - Metal Storage System.
- B. Related Sections:
 - 1. Section 096813 - Carpet Field installation of floor finish installed on floor deck panels.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A208.1 - Particleboard.
- B. American Plywood Association (APA):
 - 1. PS-1 - Product Standard for Construction and Industrial Plywood.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

2. ASTM A1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 3. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 4. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- D. National Electrical Manufacturers Association (NEMA): NEMA LD3 - High Pressure Decorative Laminates.

1.4 DESIGN REQUIREMENTS

- A. Layout: Refer to Drawings for configuration and quantities. Provide system within following limits.
1. Overall system size: 13'8-1/4" deep by 25'7-13/16" long.
 2. Maximum overall height: 94".
 3. Carriage: 24-1/4" deep by 13' long.
 4. Minimum aisle width: 43"
- B. Storage system shall be designed to adequately support live loads as calculated by manufacturer from Owner's stated storage requirements and specific Project conditions.
1. Stored material design live load: 700 pounds per linear carriage foot.
 2. Minimum floor decking support capability: 250 pounds per square foot.
- C. Mobile storage system shall be designed to manually move fully loaded carriage with appropriate gear selections to create an aisle with minimum number of hand cranks. Gear ratios shall move 3,000 to 9,000 pounds.

1.5 SUBMITTALS

- A. Provide in accordance with Division 1 - Submittal Procedures.
1. Product data for system and components.
 2. Minimum floor decking support capability: 250 pounds per square foot.
 3. Design data to determining loads, gear ratio, and anti-tip restraints.
 4. Shop drawings showing layout plans, elevations, dimensions, required tolerances, clearances, spacing of tracks, and details for fabrication, installation, connections, anchors, accessories, and interface with other elements and systems.

5. Samples:
 - a. Finish color samples for selection by Architect
 - b. 4 inches minimum length of track assembly.
6. Installer qualifications required by Paragraph 1.5.B.
7. Installation and maintenance instructions.
8. Copy of warranty required by Paragraph 1.6 for review by Architect.

1.6 QUALITY ASSURANCE

- A. Manufacturer qualifications: Storage system shall be manufactured by firm with 25 years minimum successful experience providing mobile storage systems:
- B. Installer qualifications: Experienced in installation of mobile storage systems and employee of manufacturer or certified by manufacturer for installation of specified system.

1.7 WARRANTY

- A. Provide under provisions of Section 01780 - Closeout Submittals.
 1. 5 years warranty to cover mobile storage system parts and materials against defects.
 2. 2 years warranty to cover workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. TAB, 605 Fourth Street, Mayville, Wisconsin 53050
Phone: 800-827-3288
Website: www.tab.com
- B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Division 1 - Product Substitution Procedures.

2.2 MATERIALS

- A. Steel sheet:
 1. Cold rolled steel sheet complying with ASTM A1008.
 2. Hot rolled, pickled steel sheet complying with ASTM A1011.

- B. Steel rail: SAE 1045.
- C. Cast steel wheels: SAE 1144.
- D. Extruded aluminum: ASTM B221, alloy 6063 Temper T-5.
- E. Extruded aluminum: ASTM B221, alloy 6063 Temper T-5.
- F. Plywood: 5 ply APA Structural I, Grade C-D plywood.
- G. Steel End panels, Color selected by Architect from manufacturer's full range.
- H. Grout: Non-shrink, hydraulic cement compound with 8,000 pounds per square inch.

2.3 MOBILE STORAGE SYSTEM

- A. Type: Manually operated, mechanically assisted, high density, mobile storage system consisting of track assembly and wheeled carriages which provide maneuverable platforms for storage units; TAB-TRAC Mechanical Assist Mobile Storage System as manufactured by TAB.
- B. Track: Straight section consisting of aluminum housing and steel rail. Number and spacing as determined by manufacturer to accommodate loads and performance requirements stated in Paragraph 1.3.
 - 1. Housing: Extruded aluminum section with recess for rail, 3-3/4 inches minimum base for load distribution, and holes for attachment.
 - a. Equip housing with leveling screws capable of 1/16-inch adjustment.
 - b. Where required to meet design requirements specified in Paragraphs 1.3.D and 1.3.E, provide aluminum anti-tip track housing to engage anti-tip bracket and roller guide attached to carriage bottom.
 - c. Housing shall protect steel rail from rust and corrosion and allow rail to be removed and replaced without removing complete track assembly.
 - 2. Rail: 5/8-inch square cold rolled steel bar. Rail material shall match carriage wheel steel to minimize friction and ensure smooth movement.
 - 3. Joints: Tongue and groove connection such that rail joints do not coincide with housing joints thus ensuring horizontal and vertical continuity.
 - 4. Seals: Insert neoprene, compressible tube, flush seals between rail and housing to prevent debris from hindering carriage movement.
 - 5. Stops: Where required by layout, provide stops to prevent carriages from running off track.

- C. Mobile carriages: Low profile, wheeled, rigid, steel frame supporting storage units.
1. Framework: Fabricate from 12 gauge, cold rolled steel side and cross channels with all welded joints.
 2. Nominal height of carriage above track: 3-1/2 inches maximum.
 3. Joints: Fabricate carriages in single or maximum possible lengths. When required, carriage splices shall be bolted type designed to maintain alignment and rigidity.
 4. Wheels: 3.75 inches minimum diameter, precision ground solid steel wheel. Steel material shall match rail steel to minimize friction and ensure smooth movement.
 - a. Guide wheels: Provide 4 minimum dual flange wheels per carriage.
 - b. Drive wheels: Fit wheels on drive shaft with two permanently sealed bearings housed in self-aligning flanged pillow blocks.
 5. Drive shaft: 3/4-inch minimum diameter solid steel rod connected to all drive wheels with positive keyway coupling that will not loosen.
 6. Bumpers: Equip carriages with 3/4-inch resilient bumpers to provide safety gap between end panels in closed position.
- D. Fixed carriages: Where indicated on Drawings or required by storage layout, provide fixed carriages of same height and construction as movable carriages. Permanently anchor carriages to floor such that storage unit heights are uniform.
- E. Drive system: Manually operated, mechanically assisted, geared reduction, internal drive assembly with handwheel.
1. Operation: Movement accomplished by chain and sprocket drive system. There shall be no play in drive handle and carriage shall stop without drifting when handle operation ceases.
 2. Dual controls: Provide carriages with two crank handle drive systems to permit operation of mobile carriages from either end.
 3. Housing: Drive mechanism including all chains and sprockets shall be concealed with [20 gauge] [1.00 mm] steel sheet housing mounted on carriage end. Housing shall be designed to allow access to drive mechanism for maintenance.
 - a. All chain tension adjustment plates to be concealed and tamper proof.
 4. End panels: Provide carriages with end panels which conceal all chains and sprockets of drive mechanism. End panels shall be designed to allow access to drive mechanism for maintenance.

- a. Size: Full height and depth of storage unit by 1-1/2 inches minimum thickness.
 - b. Construction: 20-gauge steel sheet with paint finish.
- 5. Handwheel: 3 spoke, ergonomic design with rotating knobs allowing direct pull up or down from any possible starting position to initiate carriage movement.
 - 6. Hand wheel safety lock: Provide push/pull knob, two pin lock mechanism for handwheel to prevent movement of carriage. Fluorescent orange visual indicator shall alert user to locked status.
 - 7. Hand wheel mounting: Handle to be installed to a steel chain guard housing independently from the end panel.

2.4 DECKING SYSTEM

- A. Type: Modular assembly of steel support channels and floor panels installed between surface mounted parallel tracks.
- B. Total floor deck assembly height from floor high point: 1-3/4 inches maximum.
- C. Floor panels: 3/4-inch-thick, particleboard.
- D. Deck support channels: 16 gauge 2 inches wide, steel channels spaced at 12 inches and anchored to concrete substrate.
- E. Ramps: At exposed edges of floor decking system provide ramp sections transitioning from floor to top surface of floor decking.
 - 1. Maximum slope: 1 in 12.
 - 2. Minimum ramp depth: 24 inches.
 - 3. Construction: Particleboard to match floor decking panels with aluminum threshold.
 - 4. Ramps shall be attached to decking systems and rigidly anchored to floor substrate.
- F. Floor deck panels and ramps shall not extend beyond end of carriages into main access aisles.

2.5 ACCESSORIES

- A. Provide fasteners, anchors, other attachment hardware, lateral braces, and other accessories as indicated on approved shop drawings and as required for complete, rigid, functional installation.

2.6 FACTORY FINISH

- A. All steel parts shall receive factory applied finish capable of withstanding 250 hours salt spray tested in accordance with ASTM B117.
 - 1. Thoroughly clean steel parts in multi-stage washer followed by application of phosphate coating.
 - 2. Electrostatically apply commercial enamel.
 - 3. Color: As selected by Architect from manufacturer's standard as provided by TAB.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field verify dimensions and Project conditions prior to fabrication.
- B. Prior to installation, verify that floor structure to receive mobile storage system has been designed and constructed to accommodate potential loads as specified in Paragraph 1.3.B.

3.2 INSTALLATION

- A. Install mobile storage system in accordance with manufacturer's installation instructions and approved shop drawings.
- B. Accurately layout storage system and location of tracks. Use manufacturer provided spacers to ensure tracks are correctly positioned and parallel. Ensure that manufacturer recommended wall clearances are maintained.
- C. Surface mounted track installation:
 - 1. Anchor track to concrete floor slab with expansion anchors of type, size, and spacing recommended by manufacturer. Use leveling screws to adjust tracks such that top will be flush with floor decking.
 - 2. Tightly pack grout under track housing. Allow to cure. Exercise care to maintain track alignment and spacing.
- D. Floor decking installation:
 - 1. Position steel channel floor supports between and perpendicular to tracks. Space at 12 inches. Anchor to concrete substrate.
 - 2. Set floor deck panels between tracks and resting on support channels and steel channel floor supports. Attach panels directly to floor with flush screws and plastic sleeve anchors.

3. Where indicated on approved shop drawings install ramp section. Attach to decking system and rigidly anchor to floor substrate.
- E. Carriages: Assemble carriages and place on track. Attach drive mechanism, covers, and end panels. Operate each carriage to ensure proper function and smooth movement. Adjust and correct deficiencies prior to mounting storage units.
- F. Storage units: Assemble storage units as specified in [Section 10671 - Metal Storage System L&T shelving. Securely bolt units to carriages. Install components plumb and level, rigid, accurately fitted, and free from distortion and defects.
- G. Field quality control: Operate all mobile storage modules through full range of movement. Ensure proper, smooth, safe operation. Verify correct operation of locks and safety devices. Correct deficiencies and adjust as required.

3.3 CLEANING

- A. Remove protective wrappings.
- B. Clean metal surfaces using clean water and mild detergent. Do not use abrasive agent, steel wool, or harsh chemicals. Rinse with clean water.

3.4 DEMONSTRATION

- A. Demonstrate to Owner's designated representatives, complete operation and required maintenance for mobile storage system.

END OF SECTION 106720

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230529

HANGERS AND SUPPORTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fastener systems.
 - 2. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.2 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under support for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548**VIBRATION CONTROLS FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Elastomeric hangers.
 - 2. Spring hangers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS**2.1 VIBRATION ISOLATORS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.

- B. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- C. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL INSTALLATION

- A. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- B. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.2 ADJUSTING

- A. Adjust active height of spring isolators.

END OF SECTION 230548

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SECTION 230553

IDENTIFICATION FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Duct labels.

1.2 ACTION SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.

- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

SECTION 230593**TESTING, ADJUSTING, AND BALANCING FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:****1. Balancing Air Systems:**

- a. Constant-volume air systems.
- b. Variable-air-volume systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 ACTION SUBMITTALS**1.4 INFORMATIONAL SUBMITTALS**

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 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 indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow

of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.

3.6 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.

3.7 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.8 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.

2. Air Outlets and Inlets: Plus or minus 10 percent.

3.9 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Fan drive settings including settings and percentage of maximum pitch diameter.
 - d. Settings for supply-air, static-pressure controller.
 - e. Other system operating conditions that affect performance.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, concealed return located in unconditioned space.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General" and "Indoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Microlite.
 - b. Knauf Insulation; Friendly Feel Duct Wrap.
 - c. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; 800 Series Spin-Glas.
 - b. Knauf Insulation; Insulation Board.
 - c. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.4 SEALANTS

A. FSK Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.8 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

- B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
- b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- 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) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
 - D. Wire: 0.062-inch soft-annealed, galvanized steel.
 - 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. C & F Wire.
- 2.10 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, concealed return located in unconditioned space.
- B. Items Not Insulated:
 1. Factory-insulated flexible ducts.
 2. Factory-insulated plenums and casings.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Factory-insulated access panels and doors.

3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design:** Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance:** Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces:** Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.

- b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 4. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 5. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner

- manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 3. Supply-air ducts, dampers, actuators, and turning vanes.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide drainage and cleanup for wash-down procedures.
 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.6 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel as follows:

B. Supply Ducts:

1. Ducts Connected to Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.

- b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- F. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Fire dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Duct-mounted access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.
 - 9. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff; a division of PCI Industries, Inc.
 - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.

- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch-thick, galvanized sheet steel, with welded corners.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Stainless steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. METALAIR, Inc.
 - b. Pottorff; a division of PCI Industries, Inc.
 - c. Ruskin Company.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 - 6. Blade Axles: Stainless steel.
 - 7. Bearings:

- a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
 1. Size: 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

- 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. Greenheck Fan Corporation.
 2. METALAIR, Inc.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Frames:
 1. Hat shaped.
 2. Galvanized-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- C. Blades:
 1. Multiple blade with maximum blade width of 8 inches.
 2. Opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch-diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

- 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. Greenheck Fan Corporation.
 2. METALAIRE, Inc.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

- 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. Ductmate Industries, Inc.
 - 2. METALAIRE, Inc.
 - 3. SEMCO Incorporated.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

2.8 DUCT-MOUNTED ACCESS DOORS

- 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. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff; a division of PCI Industries, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 3. Control devices requiring inspection.
 - 4. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.

- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- M. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fan-powered air terminal units.
 - 2. Shutoff, single-duct air terminal units.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 2. Design Calculations: Calculations for selecting hangers and supports.

1.4 ACTION SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:
1. Price Industries.
 2. Titus.
 3. Trane.
- B. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1-inch- thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal, located at plenum air inlet.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.
- F. Motor:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Type: Permanent-split capacitor with SCR for speed adjustment.
 3. Fan-Motor Assembly Isolation: Rubber isolators.

4. Enclosure: Open dripproof.
 5. Enclosure Materials: Rolled steel.
 6. Efficiency: Premium efficient.
 7. Motor Speed: Multispeed.
 - a. Speed Control: Infinitely adjustable with electronic controls.
- G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: 1 inch, glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Stage(s): SCR Control
 2. Access door interlocked disconnect switch.
 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 4. Nickel chrome 80/20 heating elements.
 5. Airflow switch for proof of airflow.
 6. Fan interlock contacts.
 7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 8. Mercury contactors.
 9. Magnetic contactor for each step of control (for three-phase coils).
- I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 3. Disconnect Switch: Factory-mounted, fuse type.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- K. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
1. Damper Actuator: 24 V, powered closed, spring return open.
 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet,

factory calibrated to minimum and maximum air volumes, and having the following features:

- a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 - d. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."
3. Room Sensor: Wall mounted, with temperature set-point adjustment and access for connection of portable operator terminal.

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Price Industries.
 2. Titus.
 3. Trane.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1-inch- thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary

automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fan interlock contacts.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
7. Mercury contactors.
8. Magnetic contactor for each step of control (for three-phase coils).

G. Direct Digital Controls: Single-package unitary controller and actuator

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- B. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 3. Verify that controls and control enclosure are accessible.
 4. Verify that control connections are complete.
 5. Verify that nameplate and identification tag are visible.
 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

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SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear slot diffusers.
4. Adjustable bar registers and grilles.
5. Fixed face registers and grilles.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Plaque.
7. Mounting: T-bar.
8. Pattern: Adjustable.
9. Dampers: Butterfly.

2.2 REGISTERS AND GRILLES

A. Fixed Face Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
5. Core Construction: Removable.
6. Frame: 1 inch wide.
7. Mounting: Lay in.

2.3 SOURCE QUALITY CONTROL

- ### A. Verification of Performance:
- Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- #### A. Install diffusers, registers, and grilles level and plumb.
- #### B. Ceiling-Mounted Outlets and Inlets:
- Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- #### C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

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SECTION 260010**BASIC ELECTRICAL REQUIREMENTS****PART 1 - GENERAL****1.01 GENERAL**

- A. Basic Requirements: The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. General Provisions: Provide all labor, materials, equipment, and incidentals required to make ready for use complete electrical systems as specified herein and shown on the drawings.
- C. Provide and Install: The word "provide" where used on the Drawings or in the Specifications shall mean "furnish, install, mount, connect, test, complete, and make ready for operation". The word "install" where used on the Drawings or in the Specifications shall mean "mount, connect, test, complete, and make ready for operation". Perform work required by, and in accordance with, the Contract Documents.
- D. Installation: Provide and place in satisfactory condition, ready for proper operation, raceways, wires, cables, and other material needed for all complete electrical systems required by the Contract Documents. Additional raceways and wiring shall be provided to complete the installation of the specific equipment provided. Include auxiliaries and accessories for complete and properly operating systems. Provide electrical systems and accessories to comply with the NEC, state and local codes and ordinances. It is the intent of these Specifications that the electrical systems be suitable in every way for the use intended. Material and work which is incidental to the work of this Contract shall be provided at no additional cost to the Contract.
- E. Field Connections: Provide field connections to remote equipment and control panels provided under other Divisions of these Specifications. Provide raceway, wire, and interconnections between equipment, transmitters, local indicators, and receivers. Provide 120V and low voltage surge protection equipment in accordance with Section 264313 at equipment as required. Install field connections to "packaged" equipment provided under other Divisions of these Specifications.

1.02 SCOPE OF WORK

- A. General: Provide labor, materials, permits, inspections and re-inspection fees, tools, equipment, transportation, insurance, temporary protection, temporary power and lighting, supervision and incidental items essential for proper installation and operation of the Electrical systems indicated in the Contract Documents. Provide materials not specifically mentioned or indicated but which are usually provided or are essential for proper installation and operation of the Electrical systems indicated in the contract documents.

- B. Notices: Give notices, file Plans, pay fees, and obtain permits and approvals from authorities having jurisdiction. Include all fees in the Bid Price.

1.03 INTERPRETATION OF DRAWINGS

- A. General: The Drawings are diagrammatic and are not intended to show exact locations of Raceway runs, outlet boxes, junction boxes, pull boxes, etc. The locations of equipment, appliances, fixtures, Raceways, outlets, boxes and similar devices shown on the Drawings are approximate only. Exact locations shall be determined and coordinated in the field. The right is reserved to change, without additional cost, the location of any outlet within the same room or general area before it is permanently installed. Obtain all information relevant to the placing of electrical work and in case of interference with other work, proceed as directed by the Architect.
- B. Discrepancies: Notify the Architect of any discrepancies found during construction of the project. The Architect will provide written instructions as to how to proceed with that portion of work. If a conflict exists between the Contract Documents and an applicable code or standard, the most stringent requirement shall apply.
- C. Wiring: Each three-phase circuit shall be run in a separate Raceway unless otherwise shown on the Drawings. Unless otherwise accepted by the Architect, Raceway shall not be installed exposed. Where circuits are shown as "home-runs" all necessary fittings, supports, and boxes shall be provided for a complete raceway installation.
- D. Layout: Circuit layouts are not intended to show the number of fittings, or other installation details. Connections to equipment shall be made as required, and in accordance with the accepted shop and manufacturer's setting drawings.
- E. Coordination: Coordinate final equipment locations with drawings or other disciplines. Layout before installation so that all trades may install equipment in available space. Provide coordination as required for installation in a neat and workmanlike manner.

1.04 EQUIPMENT SIZE AND HANDLING

- A. Coordination: Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, ship the equipment in sections of specific sizes to permit the passing through the necessary areas within the structure.
- B. Handling: Equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.05 RECORD DRAWINGS

- A. Production: The Contractor shall provide two (2) sets of black or blue line on white drawings to maintain and submit record "As-Built Documents". Label each sheet of the Record Document set with "Project Record Documents" with company name of the installing contractor in stamped or printed letters. One set shall be maintained at the site and at all times be accurate, clear, and complete. These drawings shall be available at all times to the Architect's field representatives.

- B. Recording: Record information concurrent with construction progress. Make entries within 24 hours upon receipt of information. The "As-Built" drawings shall accurately reflect installed electrical work specified or shown on the Contract Documents.
- C. Completion: At the completion of the Work, transfer changes with a colored pencil onto the second set and submit to the Architect. The "As-Built" drawings shall be made available to the Architect to make the substantial completion punch list.
- D. Final: Upon Contractor's completion of the Engineer's final punch list, transfer all "As-Built" conditions and all requirements by the Engineer to a reproducible set of drawings and CAD files. Submit drawings and CAD disks for review and acceptance. The Contractor shall provide updated disks which include final As-Built conditions.

1.06 ABBREVIATIONS

- A. Abbreviations: The following abbreviations or initials may be used:

A/C	Air Conditioning
AC	Alternating Current
ABV CLG	Above Ceiling
ADA	Americans with Disabilities Act
AF	Ampere Frame
AFF	Above Finished Floor
AFG	Above Finished Grade
AHU	Air Handler Unit
AIC	Amps Interrupting Capacity
AL	Aluminum
AMP	Ampere
ANSI	American National Standards Institute
ASA	American Standards Association
AT	Ampere Trip
ATS	Automatic Transfer Switch
AUX	Auxiliary
AWG	American Wire Gauge
BC	Bare Copper
BIL	Basic Impulse Level
BMS	Building Management System
BRKR or BKR	Breaker
CAB	Cabinet
C	Conduit or Raceway
CB	Circuit Breaker
CBM	Certified Ballast Manufacturers
CCTV	Closed Circuit Television
CKT	Circuit
CLEC	Clock Equipment Cabinet
CLG	Ceiling
CO	Conduit or Raceway Only
COAX	Coaxial Cable
COND	Conductor
CONN	Connection

CPU	Central Processing Unit
CRT	Cathode Ray Terminal (Video display terminal)
CT	Current Transformer
CU	Copper
CW	Cold Water
DC	Direct Current
DDC	Direct Digital Control
DEG	Degree
DISC	Disconnect
DO	Draw Out
DN	Down
DPST	Double Pole Single Throw
EMT	Electrical Metallic Tubing
EO	Electrically Operated
EOL	End of Line Resistor
EWC	Electric Water Cooler
FAAP	Fire Alarm Annunciator Panel
FACP	Fire Alarm Control Panel
FCU	Fan Coil Unit
FLA	Full Load Amperes
FM	Factory Mutual
GF	Ground Fault
GFCI	Ground Fault Circuits Interrupter
GND	Ground
HOA	Hand-Off-Automatic
HORIZ	Horizontal
HP	Horsepower
IC	Intercom
ICU	Intensive Care Unit
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMC	Intermediate Metallic Raceway
IN	Inches
IT	Instantaneous Trip
IPCEA	Insulated Power Cable Engineers Association
JB	Junction Box
KCMIL	Thousand Circular Mills
KV	Kilovolt
KVA	Kilo-Volt-Amps
KW	Kilowatts
LBS	Pounds
LED	Light Emitting Diode
LT	Light
LTD	Long Time Delay
LTT	Long Time Trip
LTG	Lighting
MAX	Maximum
MCB	Main Circuit Breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
MIC	Microphone

MIN	Minimum
MLO	Main Lugs Only
MTD	Mounted
MTG	Mounting
MUX	Multiplex (Transponder) Panel
MVA	Mega Volt Amps
N	Neutral
NC	Normally Closed
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIC	Not in Contract
NF	Non Fused
NL	Non Linear
NO	Number or Normally Open
#	Number
Ø	Phase
OL	Overload
OSHA	Occupational Safety and Health Administration
P	Pole
PB	Pullbox
PIV	Post Indicator Valve
PNL	Panel
PR	Pair
PWR	Power
PF	Power Factor
PRI	Primary
PT	Potential Transformer
PVC	Polyvinylchloride
REF	Refrigerator
RGC or GRC	Rigid Galvanized Raceway
RMS	Root-Mean-Square
RPM	Revolutions Per Minute
RECPT	Receptacle
SCA	Short Circuit Amps
SD	Smoke Detector
SEC	Secondary
S/N	Solid Neutral
SPKR	Speaker
SPST	Single Pole Single Throw
SST	Solid State Trip
ST	Short Time Trip
STD	Short Time Delay
SW	Switch
SWGR	Switchgear
SWBD	Switchboard
TEL	Telephone
TTB	Telephone Terminal Board
TTC	Telephone Terminal Cabinet
TVEC	Television Equipment Cabinet

TYP	Typical
UL	Underwriters Laboratories
UON	Unless Otherwise Noted
V	Volt
VFD	Variable Frequency Drive
VSD	Variable Speed Drive
W	Wire
WP	Weatherproof
XFMR	Transformer

1.07 CODES, FEES, AND STANDARDS

- A. Application: The codes, standards and practices listed herein generally apply to the entire project and specification sections. Other codes, standards or practices that are more specific will be referenced within a particular specification.
- B. Requirements: All materials and types of construction covered in the specifications will be required to meet or exceed applicable standards of manufacturer, testing, performance, and installation according to the requirements of UL, ANSI, NEMA, IEEE, and NEC referenced documents where indicated and the manufacturer's recommended practices. Requirements indicated on the contract documents that exceed but are not contrary to governing codes shall be followed.
- C. Compliance and Certification: The installation shall comply with the governing state and local codes or ordinances. The completed electrical installation shall be inspected and certified by applicable agencies that it is in compliance with codes.
- D. Labels: Materials and equipment shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available or desired for certain types of equipment, test data shall be submitted to validate that equipment meets or exceeds available standards.

1.08 INVESTIGATION OF SITE

- A. General: Before commencing work, verify existing conditions at the premises including, but not limited to, existing structural frame, existing openings; existing wall and partition locations, existing mechanical and electrical work, equipment type, and examine adjoining work on which work is in anyway dependent.
- B. Responsibility: No waiver of responsibility for defective and inadequate work or additional cost as a result of existing conditions which should have been verified shall be considered unless notice of same has been filed by the Contractor and agreed to in writing by the Architect before the bid date.
- C. Renovation: Investigate site thoroughly and re-route raceway and wiring in area of new construction in order to maintain continuity of existing circuitry. Existing Raceways shown on plans show approximate locations only.
- D. Special Considerations: Special attention is called to the fact that there will be piping, fixtures or other items in the existing building which must be removed or relocated in

order to perform the alteration work. Include removal and relocation required for completion of the alterations and the new construction. All existing wiring that is to remain in renovated areas shall be made code compliant.

- E. Power Outage: Special attention is called to the fact that work involved is in connection with existing buildings which shall remain in operation while work is being performed. Work must be done in accordance with the priority schedule. Schedule work for a minimum outage to Owner. Request written permission and receive written acceptance from the Owner no later than 72 hours in advance of power and communication shut-downs. Perform work required at other than standard working hours where outages cannot be accepted by Owner during regular working hours. Protect existing buildings and equipment during construction.

1.09 SUPERVISION OF THE WORK

- A. Supervision: Provide one field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable sizes, type and complexity. The Superintendent shall be present at all times when work is being performed. At least one member of the Electrical Contracting Firm shall hold a State Master Certificate of Competency.

1.10 COORDINATION

- A. General: Compare drawings and specifications with those of other trades and report any discrepancies between them to the Architect. Obtain from the Architect written instructions to make the necessary changes in any of the affected work. Work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Trades shall make proper provisions to avoid interferences in a manner approved by the Architect.
- B. Obtain set of Contract Documents from Owner's Authorized Representative or Contractor for all areas of work noted above and include all electrical work in bid whether included in Division 26 Contract Documents or not.
- C. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called for in Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.
- D. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Owner.
- E. Adjustments: Locations of raceway and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Determine the exact routing and location of systems prior to fabrication or installation.
- F. Priorities: Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have the right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.

- G. Modifications: Offsets and changes of direction in raceway systems shall be made to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Provide elbows, boxes, etc., as required to allow offsets and changes to suit job conditions.
- H. Replacement: Work shall be installed in a way to permit removal (without damage to other parts) of other system components provided under this Contract requiring periodic replacement or maintenance. Raceway shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.
- I. Layout: The Contract Drawings are diagrammatic only intending to show general runs and locations of raceway and equipment, and not necessarily showing required offsets, details and accessories and equipment to be connected. Work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation, which will afford maximum accessibility for operation, maintenance and headroom.
- J. Contract Conflicts: Where discrepancies exist in the Scope of Work as to what Trade provides items such as starters, disconnects, flow switches, etc. such conflicts shall be coordinated between the divisions involved. It is the intent of the Contract Documents that all work shall be provided complete as one bid price.
- K. Drawing Conflicts: Where drawing details, plans or specification requirements are in conflict and where sizes of the same item run are shown to be different within the contract documents, the most stringent requirement shall be included in the Contract. Systems and equipment called for in the specification or as shown on the drawings shall be provided as if it was required by both the drawings and specifications. Prior to ordering or installation of any portion of work, which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.
- L. It is the responsibility of this Contractor to coordinate the exact required location of floor outlets, floor ducts, floor stub-ups, etc. with Owner's Authorized Representative and Designer (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.
- M. The Contract Documents describe specific sizes of switches, breakers, fuses, Raceways, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. Adjust circuit breaker, fuse, Raceway, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Owner.
- N. Working Clearances: Minimum working clearances about electrical equipment shall be as referenced in the applicable edition NEC Article 110, and shall include equipment installed in ceiling spaces.

1.11 DEMOLITION

- A. General: Relocate existing equipment and reroute existing raceways in areas being renovated as required to facilitate the installation of the new systems. The Owner shall require continuous operation of the existing systems, while demolition, relocation work or new tie-ins are performed.
- B. Coordination: Prior to any deactivation, relocation or demolition work, arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect equipment designated as being relocated and reused or equipment remaining in operation and integrated with the new systems.
- C. Provisions: Deactivation, relocation, and temporary tie-ins shall be provided by the Contractor. Demolition, removal and the legal disposal of demolished materials shall be provided by the Contractor.
- D. Owner's Salvage: The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.
- E. Phasing: The Contractor shall perform work in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Specified Method: Where several brand names, make or manufacturers are listed as acceptable each shall be regarded as equally acceptable, based on the design selection but each must meet all specification requirements. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Engineer's review and acceptance. Where manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance. No substitutions are permitted.
- B. Certification: When a product is specified to be in accordance with a trade association or government standard requested by the Engineer, Contractor shall provide a certificate that the product complies with the referenced standard. Upon request of Engineer, Contractor shall submit supporting test data to substantiate compliance.
- C. Basis of Bid: Each bidder represents that his bid is based upon the manufacturer's, materials, and equipment described in the Contract Documents.
- D. Space Requirements: Equipment or optional equipment shall conform to established space requirements within the project. Equipment which does not meet space requirements, shall be replaced at no additional expense to the Contract. Modifications of related systems shall be made at no additional expense to the Contract. Submit modifications to the Architect/Engineer for acceptance.
- E. Samples: Samples are to be submitted for items requested within Specification Sections to determine that the item meets specifications and requirements before being accepted for use on Project. Samples shall be submitted within 30 days after the award of the contract. Each sample shall be tagged, labeled, or marked, "Sample of for (Project).

Accompany samples with copy, in duplicate of manufacturer's instructions regarding installation, and maintenance.

1. Provide samples of the following items:

2.02 SHOP DRAWINGS

- A. General: Shop drawings shall be submitted for every item listed within the Submittals section each individual specification section. One copy shall be submitted to the Architect and Owner prior to ordering equipment. Refer to Basis of approval paragraph.
- B. Responsibility: It is the Contractors responsibility to provide material in accordance with the plans and specifications. Material not provided in accordance with the plans and specifications shall be removed and replaced at the Contractors expense.
- C. Official Record: The shop drawing submittal shall become the official record of the materials to be installed. If materials are installed which do not correspond to the record submittal they shall be removed from the project without any additional cost or delays in construction completion.
- D. Information: The shop drawing record submittal shall include the following information to the extent applicable to the particular item;
 1. Manufacturer's name and product designation or catalog number.
 2. Standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEMA, NFPA, OSHA, UL, or other organizations, including the type, size, or other designation.
 3. Dimensioned plan, sections, and elevations showing means for mounting, raceway connections, and grounding, and showing layout of components.
 4. Materials and finish specifications, including paints.
 5. List of components including manufacturer's names and catalog numbers.
 6. Internal wiring diagram indicating connections to components and the terminals for external connections.
 7. Manufacturer's instructions and recommendations for installation, operation, and maintenance.
 8. Manufacturer's recommended list of spare parts.
 9. Provide 1/2" = 1'-0" enlarged electrical room layout drawings for all electrical rooms. All equipment shall be indicated at actual size of equipment being provided. All dimensions and required working clearances shall be shown.
- E. Preparation: Prior to submittal, shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned to Contractor unreviewed.
- F. Basis of Review: Approval is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractor is responsible for quantities, dimensions, fabrication processes, and construction techniques.

- G. Responsibility: The responsibility that dimensions are confirmed and correlated with proper coordination of other trades shall be included as part of the Contract Documents. The responsibility and the necessity of providing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings shall be included as part of the Contract Documents. The Contractor is responsible for any delays in job progress occurring directly or indirectly from late submissions or re-submissions of shop drawings, product data, or samples.
- H. Ordering Equipment: No material shall be ordered or shop work started until the Engineer has officially received the shop drawings record submittal and has formally released the Contractor for submittal requirements.
- I. Brochure Requirements: Submit Technical Information Brochures at the start of construction or no later than 30 days after Award of the Contract. Each brochure shall consist of an adequately sized, hardcover, 3-ring binder for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on end of brochure. When one binder is not enough to adequately catalog all data, an additional binder shall be submitted.
- J. Brochure Contents: First sheet in the brochure shall be a photocopy of the Electrical Index pages in these specifications. Second sheet shall be a list of Project Addresses for this project. Third sheet shall list Project Information. Provide reinforced separation sheets tabbed with the appropriate specification reference number and typed index for each section in the Electrical Schedule. Technical Information consisting of marked catalog sheets or shop drawings shall be inserted in the brochure in proper order on all items specified and shown on drawings. At the end of the brochure, provide and insert a copy of the specifications for this Division and all addenda applicable to this Division.
- K. Contractor's Review: Review the brochures before submitting to the Engineer. No request for payment shall be considered until the brochure has been reviewed, stamped and submitted for review.
- L. Cost: Submit cost breakdown on work in the Technical Information Brochures. The cost of material and labor for each item shall be indicated. The cost of fittings and incidentals are not required.
- M. Title Drawings: Title drawings to include identification of project and names of Architect-Engineer, Engineer, Contractors, and/or supplier, data, number sequentially and indicate in general;
1. Fabrication and Erection dimensions.
 2. Arrangements and sectional views.
 3. Necessary details, including complete information for making connections with other work.
 4. Kinds of materials and finishes.
 5. Descriptive names of equipment.
 6. Modifications and options to standard equipment required by the contract.
 7. Leave blank area, size approximately 4 by 2-1/2 inches, near title block (for Engineer's stamp imprint).
 8. In order to facilitate review of shop drawings, they shall be noted, indicating by cross-reference the contract drawings, notes, and specification paragraph numbers where items occur in the contract documents.

9. See specific sections of specifications for further requirements.
- N. Technical Data: Submit technical data verifying that the item submitted complies with the requirements of the specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate optional equipment and changes from the standard item as called for in the specifications. Provide drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.
- O. Same Manufacturer: In general, relays, contactors, starters, motor control centers, switchboards, panelboards, dry type transformers, disconnect switches, circuit breakers, manual motor starter switches, etc., shall be supplied and manufactured by the same manufacturer. This requirement shall apply to same type of electrical components specified in other Divisions.

2.03 EQUIPMENT, MATERIALS, AND SUPPORTS

- A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacture of the type and size of equipment, shall be suitable for the environment in which it is to be installed, shall be approved for its purpose, environment, and application, and shall bear the UL label.
- B. Installation Requirements: Each item of equipment or material shall be installed in accordance with instructions and recommendations of the manufacturer, however, the methods shall not be less stringent than specified herein.
- C. Required Accessories: Provide all devices and materials, such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means, required to fasten enclosures, raceways, and other electrical equipment and materials to be mounted on structures which are existing or new.
- D. Protection: Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by the elements. Equipment shall be stored in dry permanent shelters. If apparatus has been damaged, such damage shall be repaired at no additional cost or time extension to the Contract. If apparatus has been subject to possible injury, it shall be thoroughly cleaned, dried out and put through tests as directed by the Manufacturer and Engineer, or shall be replaced, if directed by the Engineer, at no additional cost to the Contract.

2.04 IDENTIFICATION OF EQUIPMENT

- A. General: Electrical items shall be identified as specified in the Contract Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system, which it serves or controls. Refer to Identification Section of the specifications for additional information.

2.05 SURFACE MOUNTED EQUIPMENT

- A. General: Surface mounted fixtures, outlets, cabinets, panels, etc. shall have a factory-applied finish or shall be painted as accepted by Engineer. Raceways and fittings, where allowed to be installed surface mounted, shall be painted to match the finish on which it

was installed. Paint shall be in accordance with other applicable sections of these specifications.

2.06 CUTTING AND PATCHING

- A. Core Drilling: The Contractor shall be responsible for core drilling as required for work under this section, but in no case shall the Contractor cut into or weld onto any structural element of the project without the written approval of the Architect.
- B. Cutting and Patching: Cutting, rough patching and finish patching shall be provided as specified in the contract documents. Cutting and patching shall be performed in a neat and workmanlike manner. Upon completion, the patched area shall match adjacent surfaces.
- C. Openings and Sleeves: Locate openings required for work performed under this section. Provide sleeves, guards or other accepted methods to allow passage of items installed under this section.
- D. Roof Penetration: Provide roofer with pitch pans, fittings, etc., required for electrical items which penetrate the roof. Roof penetrations are to be waterproofed in such a manner that roofing guarantees are fully in force. Roof penetrations shall be coordinated with other Trades to ensure that roof warranty is not invalidated.

2.07 SLEEVES AND FORMS FOR OPENINGS

- A. Sleeves: Provide sleeves for Raceways penetrating floors, walls, partitions, etc. Locate necessary slots for electrical work and form before concrete is poured. Watertight sleeves shall be line seal type WS. Fire rated partition sleeves shall be mild steel. Sleeves shall be Schedule 40 PVC or galvanized rigid steel unless specifically noted otherwise. Size shall be one standard diameter larger than pipe being installed or of a larger diameter to below 1/4" minimum clearance.
- B. Forms: Provide boxed out forms for Raceway penetrations only where allowed by the Architect. Fill opening after Raceway installation, with equivalent material.

2.08 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. General: Thoroughly instruct the Owner's Representative, to the complete satisfaction of the Architect and Engineer, in the proper operation of all systems and equipment provided. The Contractor shall make all arrangements, via the Architect, as to whom the instructions are to be given in the operation of the systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner's Representative has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Contractor to the Owner's Representative, then the Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the Specification has been complied with.
- B. Submittals: Submit to the Architect for approval five (5) typed sets, bound neatly in loose-leaf binders, of instructions for the installation, operation, care and maintenance of

equipment and systems, including instructions for the ordering and stocking of spare parts for equipment installed under this contract. The lists shall include part number and suggested suppliers. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.

- C. Information Requirements: Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub index for each section shall also be provided.
- D. Instructions: The instructions shall contain information deemed necessary by the Architect and include but not limited to the following:
 - 1. Introduction:
 - a. Explanation of Manual and its use.
 - b. Summary description of the Electrical Systems.
 - c. Purpose of systems.
 - 2. System:
 - a. Detailed description of all systems.
 - b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.
 - 3. Operations:
 - a. Complete detailed, step by step, sequential description of all phases of operation for all portions of the systems, including start up, shutdown and balancing. Include posted instruction charts.
 - 4. Maintenance:
 - a. Parts list and part numbers.
 - b. Maintenance and replacement charts and the Manufacturer's recommendations for preventive maintenance.
 - c. Trouble shooting charts for systems and components.
 - d. Instructions for testing each type of part.
 - e. Recommended list of on-hand spare parts.
 - f. Complete calibration instructions for all parts and entire systems.
 - g. General and miscellaneous maintenance notes.
 - 5. Manufacturer's Literature:
 - a. Complete listing for all parts.
 - b. Names, addresses and telephone numbers.
 - c. Care and operation.
 - d. All pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
 - e. Internal wiring diagrams and Engineering data sheets for all items and/or equipment furnished under each Contract.
 - f. Guarantee and warranty data.

2.09 TEMPORARY LIGHT AND POWER

- A. Capacity: Make arrangements with the Owner for existing temporary service and pay all related expenses. Temporary light and power shall be provided constantly during the project dependent upon Owner's safety requirements.
- B. Lighting: Temporary light shall be based on one 200 watt lamp covering each 1,000 square foot of floor area in the building. Each room 100 square foot and over shall have a minimum of one 100-watt lamp with guards. Provide power for motors up to 3/4 horsepower only. Provisions are to be made for electric welders, if required.
- C. Outlets: Provide outlets located at convenient points so that extension cords of not over fifty (50) feet will reach work requiring artificial light or power.
- D. Other Connections: Contractors of other trades shall furnish their own cords and sockets, as may be required for their work and shall also pay for cost of temporary wiring of construction offices and shanties used by them.
- E. New Fixtures: Permanently installed lighting fixtures may be used for temporary lighting at the Contractor's option with the provision that cool white lamps for fluorescent, clear lamps for incandescent and marked temporary for other types shall be installed. At job completion, lamps shall be replaced with permanent lamps specified.
- F. Wiring: Temporary electrical work shall be furnished and installed in conformity with the National Electrical Code and in accordance with the requirements of the local ordinances and shall be maintained in a workmanlike manner throughout their entire construction period and shall be removed after installation of the permanent electrical systems. Extension cords shall be GFCI protected or shall be fed from GFCI circuit breakers.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. General: The installation of materials and equipment shall be performed in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a quality level of workmanship. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.
- B. Acceptable Workmanship: Acceptable workmanship is characterized by first-quality appearance and function, conforming to applicable standards of building system construction, and exhibiting a high degree of quality and proficiency which is judged by the Architect as equivalent or better than that ordinarily produced by qualified industry tradesmen.
- C. Performance: Personnel shall not be used in the performance of the installation of material and equipment who, in the opinion of the Architect, are deemed to be careless or unqualified to perform the assigned tasks. Material and equipment installations not in compliance with the Contract Documents, or installed with substandard workmanship and not acceptable to the Architect, shall be removed and reinstalled by qualified craftsmen, at no change in the contract price.

3.02 PROTECTION AND CLEAN UP

- A. Protection and Restoration: Suitably protect equipment provided under this Division during construction. Restore damaged surfaces and items to "like new" condition before a request for substantial completion inspection.
- B. Handling: Materials shall be properly protected and Raceway openings shall be temporarily closed by the Contractor to prevent obstruction and damage. Post notice prohibiting the use of systems provided under this Contract, prior to completion of work and acceptance of systems by the Owner's representative. The Contractor shall take precautions to protect his materials from damage and theft.
- C. Safeguards: The Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or systems provided under this contract.
- D. Cleanup: Keep the job site free from debris and rubbish. Remove debris and rubbish from the site and leave premises in clean condition on a daily basis.

3.03 SYSTEMS GUARANTEE

- A. General: Provide a one-year guarantee. This guarantee shall be by the Contractor to the Owner for any defective workmanship or material, which has been provided under this Contract at no cost to the Owner for a period of one year from the date of substantial completion of the System. The guarantee shall include lamps, for ninety days after date of Substantial Completion of the System. Explain the provisions of guarantee to the Owner at the "Demonstration of Completed System".

3.04 FINAL OBSERVATION

- A. General: Work shall be completed, and forms and other information shall be submitted for acceptance one week prior to the request for final observation of the installation.

3.05 SPECIAL CONSIDERATIONS

- A. Comply with special requirements imposed at site by Owner. This may include badging of employees, prohibition of smoking, special working hours, or special working conditions.

END OF SECTION 260010

CERTIFICATE OF COMPLETED DEMONSTRATION MEMO

Note to Contractor: Do not submit this form at the time Technical Information Brochure is submitted. Submit five copies of information listed below for checking at least one week before scheduled completion of the building. After information has been accepted and inserted in each brochure, give the Owner a Demonstration of the Completed Electrical Systems and have the Owner sign five copies of this form. Provide one signed copy for each brochure. After this has been done, a written request for a final inspection of the System shall be made.

Re: _____
(Name of Project)

(Division Number and Name)

This memo is for the information of all concerned that the Owner has been given a Demonstration of the Completed Electrical Systems on the work covered under this Division. This conference consisted of the system operation, a tour on which all major items of equipment were pointed out, and the following items were given to the Owner;

- (a) Owner's copy of Technical Information Brochure containing approved submittal sheets on all items, including the following; (To be inserted in the Technical Information Brochure after the correct tab).
- (1) Maintenance Information published by manufacturer on equipment items.
 - (2) Printed Warranties by manufacturers on equipment items.
 - (3) Performance verification information as recorded by the Contractor.
 - (4) Check-out Memo on equipment by manufacturer's representative.
 - (5) Written operating instructions on any specialized items.
 - (6) Explanation of the one-year guarantee on the system.
- (b) "As-Built" conditions as described in the record drawing specifications.
- (c) A demonstration of the System in Operation and of the maintenance procedures which shall be required.

(Name of General Contractor)

By: _____
(Authorized Signature, Title & Date)

(Name of SubContractor)

By: _____
(Authorized Signature, Title & Date)

Brochure, Instruction, Prints, Demonstration & Instruction in Operation Received:

(Name of Owner)

By: _____
(Authorized Signature, Title, Date)

cc: Owner, Architect, Engineer, Contractor, Sub Contractor and General Contractor
(List names as stated in cc: above)

SECTION 260519**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
 - 1. Single circuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
- G. Armor: Steel, interlocked.
- H. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 1. Material: Copper.
 2. Type: Two hole with standard barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260519

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SECTION 260526**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 BONDING AND EQUIPMENT GROUNDING

- A. Description of System: In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated copper system grounding conductor in accordance with specific rules of Article 250 of the NEC. Equipment grounding conductors through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panelboard, and from panel grounding bar of each panelboard to branch circuit equipment and devices.
- B. Equipment Grounding Conductors: All raceways shall have an insulated copper system ground conductor run throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill when determining conduit sizes, even though not included or shown on drawings.
- C. Bushings: Provide insulated grounding bushings on all metallic feeder conduits terminated within panelboards, switchboards or enclosed overcurrent devices. Provide insulated grounding bushings on all branch circuit conduits where concentric knockouts are used.
- D. Connection to Other Systems: Provide all required grounding and bonding connections as specified herein and as required by the National Electrical Code.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency and testing agency's field supervisor.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Dossert; AFL Telecommunications LLC.
 - 3. ERICO International Corporation.
 - 4. Fushi Copperweld Inc.
 - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 6. Harger Lightning & Grounding.
 - 7. ILSCO.
 - 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 9. Robbins Lightning, Inc.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- E. Conduit Hubs: Mechanical type, terminal with threaded hub.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 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. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Support for conductors in vertical conduit.
 - 4. Structural steel for fabricated supports and restraints.
 - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 6. Fabricated metal equipment support assemblies.

PART 2 - PRODUCTS**2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. ERICO International Corporation.
 - d. Flex-Strut Inc.
 - e. Gripple Inc.
 - f. GS Metals Corp.
 - g. G-Strut.
 - h. Haydon Corporation.

- i. Metal Ties Innovation.
 - j. Thomas & Betts Corporation; A Member of the ABB Group.
 - k. Unistrut; Part of Atkore International.
 - l. Wesanco, Inc.
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 4. Channel Width: Selected for applicable load criteria.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 5. Toggle Bolts: Stainless-steel springhead type.
 6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 102.
 - 4. NECA 105.
 - 5. NECA 111.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS**2.1 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. GRC: Comply with ANSI C80.1 and UL 6.
 - 3. ARC: Comply with ANSI C80.5 and UL 6A.

4. IMC: Comply with ANSI C80.6 and UL 1242.
5. EMT: Comply with ANSI C80.3 and UL 797.
6. FMC: Comply with UL 1; zinc-coated steel.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes:
 1. Material: Cast metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Luminaire Outlet Boxes: Non-adjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1.
- B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Cable ties.
 - 4. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

- 1. Black letters on an orange field.
- 2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded branch-circuit conductors.

- 1. Color shall be factory applied.
- 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
- 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
- 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
- 5. Color for Neutral: White.
- 6. Color for Equipment Grounds: Green.
- 7. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

- 1. Black letters on an orange field.
- 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

- 1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

- 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

2.4 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

2.5 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.6 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

2.7 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.

2.8 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

END OF SECTION 260553

SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy and vacancy sensors.
 - 2. Switchbox-mounted occupancy sensors.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Sample Warranty: For manufacturer's warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. General Requirements for Sensors:
 - 1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 - 2. Dual technology.
 - 3. Integrated power pack.
 - 4. Hardwired connection to switch.
 - 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
 - 8. Power: Line voltage.
 - 9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 12. Bypass Switch: Override the "on" function in case of sensor failure.
- 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- B. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 - 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V.
- B. Wall-Switch Sensor Tag WS1:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
 - 4. Capable of controlling load in three-way application.
 - 5. Voltage: Match the circuit voltage.
 - 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: White.
11. Faceplate: Color matched to switch.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

END OF SECTION 260923

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SECTION 262726**WIRING DEVICES****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. Standard-grade receptacles, 125 V, 20 A.
 - 2. GFCI receptacles, 125 V, 20 A.
 - 3. Toggle switches, 120/277 V, 20 A.
 - 4. Wall plates.
 - 5. Floor service fittings.
 - 6. Poke-through assemblies.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- F. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- G. Wall Plate Color: For plastic covers, match device color.
- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498 and FS W-C-596.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

C. Four-Way Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

2.5 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick, satin-finished.

2.6 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings:

1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
2. Compartments: Barrier separates power from voice and data communication cabling.
3. Service Plate and Cover: Rectangular, die-cast aluminum with satin finish.
4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
5. Data Communication Outlet: Blank cover with bushed cable opening.

2.7 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Standards: Comply with scrub water exclusion requirements in UL 514.
- C. Service-Outlet Assembly: Pedestal type with services indicated
- D. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
- E. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- F. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
- G. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:

- a. Cut back and pigtail, or replace all damaged conductors.
- b. Straighten conductors that remain and remove corrosion and foreign matter.
- c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

- 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
- 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
- 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
- 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

- 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813

FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Enclosed controllers.
 - b. Enclosed switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.

1.4 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

- 1. Motor Branch Circuits: Class RK5, time delay.
- 2. Other Branch Circuits: Class RK5, time delay.
- 3. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Molded-case circuit breakers.
 - 3. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below.
- D. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- E. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- F. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.

- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that the unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published

- data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
 1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

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SECTION 265119

LED INTERIOR LIGHTING

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 the following types of LED luminaires:
 - 1. Downlight.
 - 2. Recessed, linear.
- B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including occupancy sensors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.

- b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.2 DOWNLIGHT.

- A. Nominal Operating Voltage: 120/277 V ac.
- B. Lamp:
 - 1. Minimum 3000 lm.
 - 2. Minimum allowable efficacy of 80 lm/W.
 - 3. CRI of minimum 80. CCT of 4000 K.
 - 4. Rated lamp life of 50,000 hours to L70.
 - 5. Dimmable from 100 percent to 0 percent of maximum light output.
 - 6. Internal driver.
 - 7. User-Replaceable Lamps:
 - a. Bulb shape complying with ANSI C78.79.
 - b. Lamp base complying with ANSI C81.61.
 - 8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- C. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear finish.
 - 3. Universal mounting bracket.
 - 4. Integral junction box with conduit fittings.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Standards:
 - 1. ENERGY STAR certified.
 - 2. RoHS compliant.
 - 3. Recessed luminaires shall comply with NEMA LE 4.

2.3 RECESSED, LINEAR.

- A. Nominal Operating Voltage: 120/277 V ac.
- B. Lamp:
 - 1. Minimum 3,000 lm.
 - 2. Minimum allowable efficacy of 85 lm/W.

3. CRI of minimum 80. CCT of 4000 K.
4. Rated lamp life of 50,000 hours to L70.
5. Dimmable from 100 percent to 0 percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:
 - a. Bulb shape complying with ANSI C78.79.
 - b. Lamp base complying with ANSI C81.61.
8. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

C. Housings:

1. Extruded-aluminum housing and heat sink.
2. Painted finish.
3. With integral mounting provisions.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers:

1. Prismatic acrylic.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

F. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. NEMA LE 4.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 568/A 568M for sheet steel.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- C. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

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SECTION 265219

EMERGENCY AND EXIT LIGHTING

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. Exit signs.
 - 2. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire" Paragraph.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
 - 2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate lamps continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - b. Humidity: More than 95 percent (condensing).
 - c. Altitude: Exceeding 3300 feet (1000 m).
4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.2 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Operating at nominal voltage of 120/277 V ac.
 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.3 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.4 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:

1. Charge batteries minimum of one hour and depress switch to conduct short-duration test.

3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, batteries, signs, or luminaires that are defective.
 - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

SECTION 270010

TECHNOLOGY GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS AND DEFINITIONS

- A. Scope: This specification section applies to all Division 27 specification sections. All systems under the specifications indicated above are referenced also in this contract documents as "technology systems".
- B. Drawings and specifications: The words "drawings" and "specifications" used on this section refer to all contract drawings and specifications describing the scope of work of the technology system.
- C. Installer and Contractor: The word "installer" where used on the drawings or specifications without any further description shall reference the installer of the system under reference. The word "contractor" where used on the drawings or specifications without any further description shall reference to the General Contractor (or Construction Manager) holding the prime agreement with the owner for the construction of this project.
- D. Provide and Install: The word, "provide" where used on the drawings or specifications shall mean, "furnish, install, mount, connect, test, complete, document and make ready for operation". The word "install" where used on the drawings or specifications shall mean, "mount, connect, test, complete, and make ready for operation".
- E. The word Engineer (also referenced as A&E) where used on the drawings or specification refers to the design engineer of the project working for the project architect or the owner. It does not refer to an engineer working for the General contractor, Construction Manager or any of the installers in the project.
- F. Complete systems: All technology systems are intended to be complete systems, including all materials, labor and programming to make it an operation system. Refer to attachment 2 of this specification section for "Responsibility Matrix" document outlining the responsibility of each trade on each technology system.
- G. Active equipment: Active equipment is defined as equipment composed of electronic component and electric materials, design to work with power applied to it. Cables are not considered active equipment.

1.2 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- A. Objective: The intent of the design drawings and specifications is to provide the installer of a technology system a scope of work for bidding purposes and to make sure different bids received by the entity holding the bidding for the technology system are

at the same level of scope for comparison purposes. The drawings and specifications are not intended to show every single element of the project to produce a buyout list for the installer. In general, for all technology systems, all active components are specifically called out but small wires and small installation materials (such as nut, bolts, washers, termination blocks, clamps, ties, etc) are not indicated in the documents. Guidelines for installation of those systems are provided in the specification to allow the installer to produce the complete buyout list of materials.

- B. Accuracy: The Drawings are diagrammatic and are not intended to show exact locations of conduit runs, outlet boxes, junction boxes, pull boxes, etc. The locations of equipment, appliances, fixtures, conduits, outlets, boxes and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the Architect or Engineer during construction. Obtain in the field all information relevant to the placing of technology systems work and in case of interference with other work, proceed as directed by the Architect or Engineer.
- C. Distances: Although most drawings have a scale referenced on each sheet, the drawings are a two dimensional representation of the system, so design drawings do not indicate changes in elevation that cause additional lengths and quantities of materials. It is the responsibility of the installer of each technology system to field verify all distances before bidding to properly estimate all cable distances and materials.
- D. Discrepancies: Notify the A&E of any discrepancies found during construction of the project and do not proceed with that portion of the project, until a written definitive statement is received providing clear direction. If a conflict exists between the contract documents and any applicable code or standard, the most stringent requirement shall be included for this project. The Engineer shall make the decision regarding questionable areas of conflict.
- E. Existing Conditions: All existing conditions might not be indicated in the design drawings. The installer of each system shall check site and existing conditions thoroughly before bidding and advise the Engineer of discrepancies prior to bid.
- F. Coordination: Although design technology drawings were intended to be coordinated with other trades, the fact that installer for other non-technology system might have changes to their design drawings, requires the Contractor to produce coordination drawings for a specific space, including all elements of all trades for space planning and coordination purposes.

1.3 ABBREVIATIONS

- A. Abbreviations: The following abbreviations or initials may be used:
 - 1. ABV CLG - Above Ceiling
 - 2. AC - Alternating Current
 - 3. ADA - American Disabilities Act
 - 4. AFF - Above Finished Floor
 - 5. AFG - Above Finished Grade
 - 6. AMP - Ampere
 - 7. ANSI - American National Standards Institute

8. AWG - American Wire Gauge
9. BC - Bare Copper
10. CCTV - Closed Circuit Television
11. CATV - Community antenna television
12. CLG - Ceiling
13. COAX - Coaxial Cable
14. CPU - Central Processing Unit
15. DC - Direct Current
16. DEG - Degree
17. EMT – Electrical Metallic Tubing
18. GND - Ground
19. IDF - Intermediate Distribution Frame (Telecom Room)
20. IMC - Intermediate Metallic Conduit
21. IN - Inches
22. IP - Internet Protocol
23. JB - Junction Box
24. KVA - Kilo-Volt-Amps
25. KW - Kilowatts
26. LBS - Pounds
27. LED - Light Emitting Diode
28. MAX - Maximum
29. MDF - Main Distribution Frame (Main Telecom Room)
30. MIC - Microphone
31. MIN - Minimum
32. MTD - Mounted
33. MTG - Mounting
34. NEC - National Electrical Code
35. NECA - National Electrical Contractors Association
36. NEMA - National Electrical Manufacturers Association
37. NFPA - National Fire Protection Association
38. NIC - Not in Contract
39. OFE - Owner furnished equipment
40. OSHA - Occupational Safety and Health Administration
41. PB - Pullbox
42. PWR - Power
43. PVC - Polyvinylchloride
44. EF - Telecommunications Entrance Facility
45. TR - Telecommunications Room
46. TTB - Telephone Terminal Board
47. V - Volt
48. WP - Weatherproof

1.4 CODES AND STANDARDS

- A. Application: The codes, standards and practices listed herein generally apply to the entire project and all technology systems. Other codes, standards or practices that are more specific will be referenced within a particular specification.
- B. Requirements: All articles, products, materials, fixtures, forms or types of construction covered in the specifications will be required to meet or exceed all applicable standards

of manufacturer, testing, performance, capabilities, procedures and installation according to the requirements of ANSI, NEMA, IEEE, NEC, BICSI and TIA referenced documents where indicated and the manufacturer's recommended practices. Requirements indicated on the contract documents which exceed but are not contrary to governing codes shall be followed.

- C. Compliance and Certification: The installation shall comply with the governing state and local codes or ordinances. The completed technology system installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes.
- D. Applicability: The codes and standards and practices listed herein, and their respective dates are furnished as the minimum latest requirements. List of applicable codes:
 - 1. State Code: Florida Administrative Code
 - 2. Building Code: Florida Building Code, current version
 - 3. Manuals: Accessibility Requirements Manual - Florida Department of Community Affairs.
- E. UL Labels: All materials shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency. No equipment shall be installed if there is no labeling or listing service is available for such equipment.

1.5 MATERIALS ALTERNATES AND SUBSTITUTIONS

- A. Definitions:
 - 1. Basis of design: A product or group of products from an identified manufacturer that was used as the basis of systems layouts and installation details, part of the contract documents.
 - 2. Prototype: Is a product or a group of products that are not yet ready for commercial use because they are in the testing phase (Beta testing) of the product development.
 - 3. Alternates: Products or manufacturers listed in the contract documents as acceptable compare to the basis of design. Use of alternates shall follow the same system architecture as the basis of design.
 - 4. Obsolete: A product that has been discontinued by the manufacturer or declared in end of life, and it is no longer being manufactured.
 - 5. Substitution: A product not listed in the contract documents but capable of similar characteristics as the basis of design operating as a direct replacement in the system in reference. The installers can propose a substitution if all requirements are met as indicated in this specification.
 - 6. Substitutions that create a change in system architecture are products that create a very different system configuration impacting other trades (i.e. change in power/cooling requirements, changes in raceways layout or sizes, changes in equipment space requirements, changes in low voltage wiring layouts, types and quantities, etc) but providing a similar end result as the system/products basis of design.

- B. Use of Prototype. Prototypes are not allowed in any technology system.
- C. Use of alternates. Alternates are allowed and installer shall follow these requirements:
 - 1. Where several brand names make or manufacturers are listed as acceptable alternates each shall be regarded as equally acceptable, based on the design selection. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Engineer's review and acceptance. Where three or more manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance.
 - 2. The use of alternate products does not allow the change of system architecture with such products.
- D. Use of substitutions. Substitutions are only allowed when they meet all the requirements below:
 - 1. Substitutions are only allowed when a particular specification section for a technology system, allows the use of substitutions for that particular system.
 - 2. The performance of all substitutions components must meet or exceed those of the basis of design. Should an installer wish to submit a substitution product or a product set stated in the construction documents as 'acceptable', it shall be the responsibility of the installer to submit to the Engineer an item-for-item CROSS REFERENCE for all specifications of the product, all related specifications and product data sheets, for the proposed substitution. Use the substitution request form indicated in Addendum 1 of this specification.
 - 3. The Engineer has the authority to reject a substitution without cause and the installer shall provide the basis of design and no additional compensation.
 - 4. Substitutions of unnamed manufacturers will not be acceptable.
 - 5. Certification of substitutions: When a basis of design is specified to be in accordance with a trade association or government standard requested by the Engineer, installer shall provide a certificate that the substitution complies with the referenced standard. Upon request of Engineer, Contractor shall submit supporting test data to substantiate compliance.
 - 6. Substitutions that create a change in system architecture are not allowed.

1.6 SHOP DRAWINGS AND SUBMITTALS

- A. General: Shop drawings shall be submitted for equipment and material as indicated in the individual specification sections for each system. .
- B. Quantity of shop drawings submittals: Follow Division 1 requirements for quantity of shop drawings and submitting requirements. If the project does not have a Division 1 specification, shop drawings shall be submitted in quantity of one (1) for electronic format submittal and quantity of four (4) for hardcopies.
- C. Electronic submittals. Submittals in electronic format (PDF) are accepted.
- D. When cut sheets of products are submitted and the manufacturer cut sheets indicate several model numbers or variations of the same product, the cut sheet shall be

highlighted by the installer to indicate the specific product that will be provided for this project. Submittals received with cut sheets indicating multiple parts numbers and not highlighted will be rejected and not reviewed.

- E. Equipment and material quantities are not reviewed by the A&E as part of this submittal process. Equipment quantities are to be provided by the installer as indicated in contract documents. Approved shop drawings indicating any changes in equipment quantities or overall scope of work different from contract documents does not constitute approval by the A&E of those changes. The contract documents and any changes issued by the A&E in the form of Supplemental Information during the construction process are always to be followed for equipment quantities and scope of work.
- F. All electronic equipment prone to obsolescence and with lead times less than 3 months shall be submitted for approval no sooner than 12 month before the date set for substantial completion of the project. Electronic equipment prone to obsolescence includes devices like flat panel displays, transceivers, servers, players, workstation and routers
- G. Equipment and materials installed not in accordance with the approved shop drawings shall be replaced at installer's expense.
- H. Multiple stages of shop drawings shall be required as indicated in each specification section. For final completion and testing the installer shall provide a submittal with the following information:
 - 1. Detailed course syllabus for each type of training required in the specifications
 - 2. A proposed schedule of training sessions in compliance with the specification sections and indicating place where the training will take place.
 - 3. A copy of all training material to be used during each session.
 - 4. Test result sheets for all testing done by the installer prior to the system acceptance test.

PART 2 - PRODUCTS

2.1 IDENTIFICATION AND LABELING TAGS

- A. All conduit, cabinets, cables, wires, wiring forms, terminal blocks, and terminals shall be clearly identified with pre-printed labels or tags.
- B. The only approved types of labels for inside premise environments for any technology systems are:
 - 1. Non-laminated thermal transfer labels, printed with a high quality thermal transfer printer.
 - 2. Laminated thermal transfer labels printed with a high quality thermal transfer printer.
 - 3. Thermal transfer polyolefin tape printed with a high quality thermal transfer printer.

4. Self laminated dot-matrix labels, printed with a high quality dot matrix printer.
 5. Non-laminated dot-matrix labels, printed with a high quality dot matrix printer.
- C. For labeling of cables or equipment in outdoor environments use only marker plates attached to cable or equipment with cable ties. Do not use any labels with adhesive materials. Use different color plates for different cable types. Use only waterproof ink for writing on marker plates.
- D. Any type of write-on labels (except for outdoor marker plates), hand writing on cable jackets or directly on equipment, labels made with masking tape or any other type of tape not listed in previous paragraph are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner.
- E. Approved manufacturer:
1. Rhino,
 2. Brady,
 3. Panduit or
 4. approved equal

2.2 TECHNOLOGY EQUIPMENT AND MATERIALS

- A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacture of the type and size of equipment, shall be suitable for the environment in which it is to be installed, shall be approved for its purpose, environment, and application, and shall bear a label as indicated in paragraph 1.4.E. of this section.
- B. Installation Requirements: Each item of equipment or material shall be installed in accordance with instructions and recommendations of the manufacturer and the contract documents.
- C. Required Accessories: All equipment specified in the technology systems shall be provided with all required accessories for proper operation and mounting. Typically these accessories are not specifically indicated in the design drawings but shall be provided per this specification section. Such accessories include items such as power supplies, power cords, rack ears, rack rails, bolts, lugs, faceplates, etc.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

- A. WORKMANSHIP: The installation of materials and equipment shall be performed in a neat, workmanlike and timely manner by an adequate number of craftsmen knowledgeable of the requirements of the Contract Documents. They shall be skilled in the methods and craftsmanship needed to produce a quality level of workmanship. Personnel who install materials and equipment shall be qualified by training and experience to perform their assigned tasks.

- B. **STANDARD OF QUALITY:** To define good workmanship, all installation practices described in BICSI standards shall be followed.
- C. **PROTECTION OF EQUIPMENT:** Equipment for Technology systems shall at all times during construction be adequately protected against mechanical/chemical damage by the elements or work performed by other trades. Equipment shall be stored in dry permanent shelters. If equipment or materials have been damaged, such equipment shall be replaced at no additional cost or time extension to the Contract. Damaged equipment and materials include the following conditions:
1. Equipment that has visible scratches, cracks or equipment that has paint or finished surface peeled off.
 2. Equipment with visible indication of rust or water intrusion.
 3. Equipment that has dents on the metal enclosures and are clearly visible to the end user.
 4. Equipment that has been sprayed with paint, fire proofing materials, or other type of chemicals, when the equipment was not intended to have this type of materials applied to it, per contract documents.
 5. Equipment that has been burnt by controlled fires, power surges, power sags or by lightning.
 6. Equipment that has a known damage to any parts, electronic board or component, even if such component or board has no specific use in the project.
 7. Cables that have visible damages to the jackets even if cables are not broken and still provide electrical continuity.
 8. Cables sprayed with paints that affect the warranty of the cable as defined by the cable manufacturer.
 9. Equipment with screws with stripped heads.
- D. **CLEAN EQUIPMENT:** All equipment installed in spaces accessible to the building occupants like in racks, cabinets, wall mounted panels, credenzas, etc. shall be free of dust at the time the space part of the project gets the final Certificate of Occupancy and at the time of the acceptance test by the A&E. A clean equipment is defined as an equipment that if wiped with a finger, in any surface, does not leave visible debris and dust in the finger, also equipment with no visible signs of dust inside the equipment, like in ventilation fans..
- E. **IDENTIFICATION AND TAGGING:** All technology systems items shall be labeled and identified as specified in the Contract Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system which it serves or controls. Refer to Identification Section of the specifications for additional information. All labels of equipment and wiring shall match the labeling used in the shop drawings for the system.

3.2 COORDINATION

- A. **General:** The installer shall compare shop drawings with those of other trades and report any conflicts between them to the A&E. Obtain from the A&E written instructions to make the necessary changes in any of the affected work. All work shall be installed in cooperation with other Trades installing interrelated work.

- B. Adjustments: Locations of conduit and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Determine the exact routing and location of all systems prior to fabrication or installation.
- C. Replacement: All work shall be installed in a way to permit removal (without damage to other parts) of all other system components provided under this Contract requiring periodic replacement or maintenance. All conduits shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles.

3.3 REQUEST OF IP ADDRESSES

- A. General: When contract document require the installer of any of the technology systems to use IP addresses for the configuration of such system, inside the owner's controlled IP network, the installer shall request the owner to provide such IP addresses. The installer shall request such information no less than one (1) month in advance from the moment the installer will be programming the system and by using the form named "Network Connections Programming Plan" indicated in Attachment 3 of this specification. An electronic copy of this form is available upon request from TLC Engineering.
- B. Completing the form. The Network Connections Programming plan shall be completed in separate by each trade that requires IP addresses. This form has two parts. The first part indicates all the different device types for a system (i.e. cameras, workstation, servers, controllers, VoIP phones, etc). The second part is a list of all devices required classified by their type and properly indicating location where the device will be used.
- C. Request that do not follow this process, or have incomplete information will be ignored and will not be processed.
- D. Reprogramming cost of any technology systems due to un-approved addresses used by the installer shall be at the installer's expense

3.4 TELECOM ROOM/EQUIPMENT ROOM READINESS

- A. In any projects where the technology systems require the use of network equipment (switches, routers, firewalls, etc) provided by the owner, the Contractor shall complete all telecom rooms to a point where they are suitable for the owner to deploy such equipment in those rooms. At a minimum the following conditions shall be meet at all rooms in order for the owner to install the equipment:
 - 1. All power outlets in the telecom rooms shall be feed from the permanent source of power. Temporary power shall not be provided.
 - 2. Backup power (generator and/or UPS) shall be already operation, tested and connected to the final power distribution system.
 - 3. The mechanical equipment providing the cooling for the telecom rooms shall be fully operational. Temporary cooling shall not be accepted.
 - 4. Fire suppression system (sprinkler or gas based system) protecting the telecom rooms shall be fully operational and tested.
 - 5. All light fixtures in the telecom room's hall be fully operational.

6. All walls to the telecom rooms shall be completed and including the last coat of paint.
 7. The ceiling and flooring of the telecom rooms shall be finished.
 8. All horizontal and backbone cabling system part of the structured cabling system (SCS) shall be installed, terminated and tested.
 9. The final and permanent doors to the telecom rooms shall be installed with a key core different from all other construction cores in the site.
 10. Telecom rooms shall be cleared of any materials being stored inside the room.
 11. Telecom rooms shall be clean. Clean will be measured as not having any debris left in the room and not having dust in rack, cabinets, or wall mounted panels. If wiping a finger in any of the surfaces of such equipment leaves visible dust residue in the finger, the room will not be considered clean.
 12. Hallways and rooms leading into the telecom rooms shall have no more sanding to be done in the walls and the floor shall be completed to avoid dust from these spaces moving into the telecom rooms.
 13. Prior to the owner deploying the equipment in these rooms, the Contractor shall provide disposable sticky mats at the entrance of each telecom room to capture dust and/or dirt from people's shoes or boots coming into the room. The sticky mats shall be selected as to cover the width of the door opening. Sticky mats shall contain no less than 60 sheets in each unit. Used sheets of the mats shall be replaced no less than on a daily basis or if worn out before the end of the day. Sticky mats shall be provided until the project receives the final Certificate of Occupancy.
- B. In projects where the network equipment is part of the contract documents, the contractor is required to provide all equipment functioning and clean at the end of the project. The contractor is responsible to determine at what point this delicate equipment can be installed in the telecom room. The contractor shall make sure the recommended manufacturer guidelines are applied to the installation of the equipment when it comes to cleanness. It is highly recommended that all steps indicated above are followed even for this type of project.

3.5 SYSTEMS WARRANTY AND SERVICE

- A. General: At a minimum all technology system shall include a warranty from the manufacturer and installer of the system for no less than one (1) year with the following exceptions:
1. Structured Cabling system shall have a warranty longer than one year as indicated in that specification section.
 2. When specific equipment or software manufacturers include a warranty longer than one year, the manufacturer's warranty shall be transferred to the owner in the same terms as indicated by the manufacturer.
- B. Warranty coverage. The warranty for the technology system shall cover the following elements:
1. All equipment parts, cabling and materials.
 2. Any software updates/patches issued during the warranty period by the manufacturer.

3. The labor to replace those parts and programming time to re-configure equipment.
 4. Shipping and freight charges to send equipment back and forth from the manufacturer and/or site.
 5. Tool rentals such as scaffold or lifts to access equipment.
 6. The troubleshooting time to detect the faults in the system.
 7. All travel time and expenses associated with the service.
- C. Start of warranty. The warranty period for the technology systems starts the day the project gets the Certificate of Occupancy (CO), for new construction projects. For retrofit jobs of a particular system, the warranty starts when the project is accepted by A&E. For most equipment/software manufacturer's the warranty period starts when the equipment is shipped from the factory, so it is the responsibility of the installer of each system to provide additional warranty coverage from the manufacturer to cover the additional time of warranty up to the CO date plus one year.
- D. Service calls. During the warranty period the installer shall support the system when called by owner/contractor for service. All equipment/software service shall be done by personnel with the same qualifications as the personnel who installed the system and as indicated in each technology system specification section. Service calls shall be taken during business hours (same time zone as the project) for normal service and twenty (24) hours three hundred and sixty five (365) days in the year for emergency service. Emergency Service shall be defined as the loss or failure of any critical component necessary to maintain the overall integrity and operation of the system. Normal service shall be defined as the loss or failure of a system component that does not compromise the complete operation of the system and allows the owner to operate the system at a minimum of 90% of its capacity. See individual specification sections for delineation on critical components and normal service.
- E. Response time for service. The maximum allowed response time after a service call for emergency service shall be four (4) hours and for normal service twenty four (24) hours.
- F. Equipment registration. All equipment/software part of the technology system shall be registered to the owner with the manufacturer of the equipment/software for warranty and support. Equipment/software registered with the manufacturer to the name of the Contractor or installer shall be removed from the project and replaced with equal equipment registered to the owner at no additional cost to the owner.
- G. Periodic preventive maintenance visits. During the warranty period the installer of the system shall provide no less than two (2) preventive maintenance services. These services shall be provided at 6 months from start of the warranty period and a few weeks before the end of the warranty period. The installer of the system shall coordinate with the owner the precise dates for this type of service. During these visits the following task shall be perform:
1. Clean up of any active equipment that shows visible accumulation of dirt, dust of debris of any kind.
 2. Replacement of any consumable parts in the system that require replacement per manufacturer's instructions during the warranty period, such as filters.

3. Oiling/greasing of any mechanical parts that require period maintenance as per manufacturer's instructions during the warranty period.
 4. Run manufacturer's recommended test for each piece of equipment installed. The installer shall provide at the end of the service a report of such test.
 5. Visual observation of all devices in the system to spot any anomalies.
 6. Review of error logs from any system components and analysis of such logs with explanation to owner on the cause of those errors.
- H. Extended service agreement. Prior to final acceptance testing, and within thirty 30-days of project completion, the installer of each technology system shall submit to the Owner an option to purchase extended service coverage. This proposal shall provide for the purchase option of 1, 3, or 5, year coverage. Coverage shall include, at a minimum, the same provisions as during the warranty period.

3.6 COMISSIONING

- A. This project will be commissioned by the A&E or by a third party company designated by the owner. The commissioning process will consist of a third party testing by the commissioning agent of a percentage of the installed infrastructure.
- B. The installer of each system shall notify the owner when the project is ready for commissioning. The installation is ready for commissioning once the installer is complete with the testing of the system and the identification process has been completed.
- C. The installer shall be available on site to resolve any results discrepancies between the test results provided by the installer of the system and the commissioning agent.

3.7 ENGINEER'S FINAL ACCEPTANCE TEST

- A. The technology systems shall be tested during installation by the installer as frequently as required to solve any installation issues and non compliance of system specifications. Technology systems will not be considered delivered to the owner until final acceptance test is passed. The final acceptance test shall be done in presence of the A&E and/or the owner. The installer shall request in writing with 2 weeks in advance the presence of the A&E and/or owner for the final acceptance test.
- B. In order for the installer of the system to request final acceptance the following task shall be completed:
 1. All components shall be inspected to ensure they have been properly installed by the installer, securely attached, and remain clean and unmarred
 2. All equipment shall be properly adjusted, clearly labeled, and fully operational.
 3. The installer shall have tested the system previously to ensure the final acceptance test will be successful. Detailed proof of test shall be sent to the A&E with the request for final acceptance
 4. All permanent and final labels as requested in the identification and tagging section of this specification are completed.
 5. No temporary conditions shall be present in the system.

6. All batteries on all system components shall be connected.
 7. All system programming shall be completed as indicated in the specification for each technology system.
- C. All test equipment required for the Final acceptance shall be provided by the installer of the system unless specifically indicated by the A&E.
 - D. The A&E shall define the scope of the testing but the installer shall be prepared for testing every single component of the system. During the day of the test the A&E will indicate the testing process and procedures for each system. Test could include operation of the system during power outages. The installer of the system shall be available during the complete testing process to answer questions from the Engineer and to demonstrate specific parts of the system. If personnel from the installer or test equipment is not available, the test will be considered and marked as a failure.
 - E. A punch list of the items to be corrected will be prepared by the A&E during the final acceptance test. The installer shall correct all items and request a second day for verification of all punch-list items by the A&E and Owner. During the second test, no additional punch list items shall be expected, and only the items in the punch list will be tested.
 - F. If during the testing process the A&E and/or Owner consider that the rate of failure of the test is too high (more than 5 failures or non-compliance with specifications in one hour of test), the test will be cancelled unilaterally by the A&E and/or owner. The installer shall correct all items and re-schedule the final acceptance test again. The new test will start over from the beginning and nothing previously tested will be accepted. The installer shall not be entitled to additional compensation for the additional effort to test the system during this condition. To the contrary, the Contractor/Installer shall reimburse the owner of the project with the cost of the additional hours of testing required to be spent by the A&E and owner's team. The rate to be used for this reimbursement will be \$150 per hour per person required by the A&E and Owner to complete the test.
 - G. Upon successful completion of the final acceptance test the installer of the system will receive a written notice by the A&E and/or Owner acknowledging the acceptance of the test
 - H. See individual specification sections for system specific requirements for testing.

3.8 TRAINING AND INSTRUCTION

- A. Training for each technology system shall be provided as indicated in this specification and in the individual specification section for each system.
- B. The following training guidelines shall be followed for all technology system:
 1. Training shall not be scheduled in a way that no attendee or presenter shall be required to attend more than 6 hours of training per day.
 2. Prior to starting all training, the training submittal shall be approved. See section one of this specification for details on the training submittal

3. No training shall be scheduled prior to the system being completed and accepted by the A&E.
4. Training shall be conducted during normal business hours of the client, at a date and time of mutual convenience to the Owner and installer. All training sessions need to be scheduled by the installer at least 2 weeks in advance. The Owner shall be notified in writing by the installer on when are the possible dates for each session.
5. All different types of training shall be videotaped and delivered to the owner as part of the close out information in digital copy. All tapes shall be recorded in hi-quality MPEG2 or HD recorders, and the media turned to the owner shall be in electronic format viewable through QuickTime or Windows Media Player.
6. The installer is responsible for completing list of attendants for each session of training. All these sheets shall be submitted as part of the close out information

3.9 AS BUILT DOCUMENTS

- A. Production: During the course of this project the contractor shall maintain record "as-built drawings". One set shall be maintained at the site and at all times and it shall be accurate, clear, and complete, showing the actual location of all equipment as installed. The "As-Built" drawings shall show all technology systems work installed complete to the present stage of progress. These drawings shall be available for review by the A&E's field representatives at all times.
- B. Completion: At the completion of the Work, transfer onto the second set of drawings all changes marked in colored and submit to the A&E.
- C. Final: Upon installer's completion of the Engineer's final punch list, transfer all "As-Built" conditions and all requirements by the Engineer to a reproducible set of drawings. Submit full size drawings and one (1) set of CAD/Autodesk Revit© disks for review and acceptance.
- D. Additional documents. At project completion, the installer of the technology system shall provide, as part of the as-built documents, updated tables, equipment schedules, configuration worksheets and labeling system used. See individual system specification section for more details on these documents.
- E. See individual specification sections for each system for additional requirements for As-Built documents.

3.10 CLOSE OUT DOCUMENTS

- A. Closeout information shall be provided to the owner in electronic format at the end of the project. The file shall be organized by each system and shall follow this organization:
 1. PART 1 – OPERATION AND MAINTENANCE MANUALS. Operation and Maintenance manuals as issued by the manufacturer of each system's component. Such manuals shall include all maintenance procedures required to

- be done by the owner. Also, when required by each individual specification section, a short form operation guide, prepared by installer) for the system.
2. PART 2 – INVENTORY OF EQUIPMENT INSTALLED. A detailed list of all relevant active equipment (equipment with electronic components with a market value over \$200) installed in the project including the following information and presented in electronic format (Microsoft Excel):
 - a. Make
 - b. Model
 - c. Serial number
 - d. Room location
 - e. Warranty period, including manufacturer's extended warranties.
 3. PART 3 – PROOF OWNERSHIP, DELIVERY AND ACCEPTANCE. The following letters/documents shall be attached in this part:
 - a. Acceptance letter signed by A&E for each of the technology systems installed.
 - b. Proof of training by submitting sign in sheets for each training session done
 - c. Signed transmittal for all training videos and training material.
 - d. Signed transmittal for all spare parts and consumables delivered to the owner.
 - e. A list of all the user names and passwords for all the different software programs used by the technology systems and any equipment with password codes. All levels of passwords shall be provided, from the lowest hierarchy to the highest.
 - f. At least four (4) copies of all physical keys to different devices part of the technology systems. Each key shall be individually tagged in a key ring. All keys shall be included and organized inside a key ring management enclosure.
 - g. A list of all software modules and licenses delivered to the owner. The list shall include part numbers, serial numbers, license certificate of authenticity, hardware key (dongles) numbers and software version. This list shall have a clear signature, name and date on person that received this software by the Owner.
 - h. A copy of all official equipment and software registrations with manufacturer.
 4. PART 4 – AS BUILT DOCUMENTS. All as-built documents as indicated in this specification section

END OF SECTION 270010

ATTACHMENT 1 – SUBSTITUTION REQUEST FORM

Substitution Request Number: _____

PROJECT: _____ DATE: _____

SPECIFICATION SECTION: _____ ITEM(S): _____

SPECIFIED MANUFACTURER: _____

SPECIFIED MODEL NO: _____

PROPOSED MANUFACTURER: _____

PROPOSED MODEL NO: _____

REASON(S) FOR NOT PROVIDING SPECIFIED ITEM: _____

Attach product description, drawings, photographs, performance and test data, samples and other information necessary for side-by-side evaluation. Fill in all blanks.

A. Provide substantiated reason for requested substitution.

B. Does the requested substitution affect dimensions, locations or configurations?

No: _____ Yes: _____

Explain (attach drawings if necessary):

C. What are the differences between the specified item and the requested item:

D. Will the Contractor pay for any changes to the building design, including engineering and detailing costs caused by the approval?

No: _____ Yes: _____

Explain (if no, and describe modifications required to install or accommodate the requested change): _____

E. Will approval affect the work of other trades, including the Construction schedule?

No: _____ Yes: _____

Explain (if yes): _____

F. Manufacturer's guarantees of the proposed and specified items are:

Same: _____ Different: _____

Explain (if different): _____

G. Does the proposed item meet all applicable codes, ordinances and regulations for this specific application?

No: _____ Yes: _____

Explain (if no): _____

H. Has proposed item been used locally in similar applications?

No: _____ Yes: _____

Explain (give nearest location): _____

I. Will maintenance and service parts be locally available for the requested item?

No: _____ Yes: _____

Explain (if no, give nearest location): _____

J. Will the requested item require waiving of any qualifications or other requirements?

No: _____ Yes: _____

Explain (if yes): _____

K. Are there any license fees or royalties associated with the requested substitution?

No: _____ Yes: _____

Explain (if yes): _____

L. If approved, will the Owner receive a credit for the proposed alternate material?

No: _____ Yes: _____

Explain (if no): _____

M. Does the proposed alternate material meet the same applicable standards (ASTM, ANSI, UL, FS) as the specified item?

No: _____ Yes: _____

Explain (if no, attach drawings if necessary): _____

- N. Identify the recycled materials or components or features that lead to the claims to being "Green": _____

- O. Has the required line-by-line comparison been included?

No: _____ Yes: _____

Explain (if no): _____

The undersigned agrees to pay for the Designer's review time and for changes to the building design, including review, re-design, engineering, drawings and other costs caused by the requested substitution.

Signature

Print

The following Purchase Order or billing number is to be used for billing the Contractor for costs incurred in evaluating and if applicable accommodating the requested substitution.

The Engineer will not be required to approve any product that is not equal or suitable for the specific application and functionality of this project.

ATTACHMENT 2 – RESPONSIBILITY MATRIX

INDIAN RIVER COURTHOUSE					
DESIGN AND CONSTRUCTION RESPONSIBILITIES					
ITEM	SYSTEM	SCOPE	DESIGN RESPONSABILITY	PROCUREMENT RESPONSABILITY	CONSTRUCTION RESPONSABILITY
1.00	VOICE SYSTEM (TELEPHONE COMMUNICATIONS SYSTEM ALL AREAS)				
1.01	RACEWAYS	Conduit, boxes, cable tray, etc.	A&E	CM	CM
1.02	INSIDE PREMISE WIRING	Structured cabling system	A&E	CM	CM
1.03	OUTSIDE PREMISE WIRING IN PRIVATE CAMPUS	Structured cabling system	A&E	CM	CM
1.04	OUTSIDE PREMISE WIRING FROM SERVICE PROVIDERS	Fiber and copper for services	TLC/Owner	S.P.	S.P.
1.05	PATCHING OF VOICE LINES	Patching at path panel and work areas	A&E	N.A.	OWNER
1.06	PHONE SWITCH	Equipment selection, sizing, equipment layout, RFP	OWNER	OWNER	OWNER
2.00	DATA SYSTEM (COMPUTER NETWORKS ALL AREAS)				
2.01	RACEWAYS	Conduit, boxes, cable tray, etc.	A&E	CM	CM
2.02	INSIDE PREMISE WIRING	Structured cabling system	A&E	CM	CM
2.03	PATCHING OF DATE LINES LINES	Patching at path panel and work areas	A&E	N.A.	OWNER
2.04	ACTIVE ELECTRONICS (NETWORKING EQUIPMENT, SWITCHES, ROUTERS, SERVERS AND COMPUTERS)	Equipment selection, sizing, equipment layout, RFP	OWNER	OWNER	OWNER
3.00	TELECOM ROOM OUTFIT				
3.01	PLYWOOD AND WALL SLEEVES	Plywood and sleeves for cables	A&E	CM	CM
3.02	GROUNDING SYSTEM	Ground bar and ground bus	A&E	CM	CM
3.02	RACKS, WIRE MANAGERS AND LADDER TRAY	Racks and all passive elements	A&E	CM	CM
4.00	AV SYSTEMS FOR COURTROOM				
4.01	RACEWAYS	Conduit, boxes, cable tray, etc.	A&E	CM	CM
4.02	INSIDE PREMISE WIRING	AV wiring for systems	A&E	CM	CM
4.03	ACTIVE ELECTRONICS	Projectors, presentation control system, paging system, etc.	TLC/OWNER	CM	CM
5.00	SECURITY SYSTEMS, BUILDING CCTV AND ACCESS CONTROL				
5.01	RACEWAYS	Conduit, boxes, cable tray, etc.	A&E	CM	CM
5.02	INSIDE PREMISE WIRING FOR CAMERAS	Cables for cameras	A&E	CM	CM
5.03	INSIDE PREMISE WIRING FOR CARD ACCESS	Cables for card access, readers, locks, dps, etc.	OWNER	OWNER	OWNER
5.04	ACTIVE ELECTRONICS	Cameras, DVRs, Access control panels, readers, etc.	OWNER	OWNER	OWNER
5.05	LOCKING DEVICES	Magnets, electric mortise locks	A&E	CM	CM
6.00	EMERGENCY POWER BACKUP (UPS) FOR ACTIVE EQUIPMENT				
6.01	POWER WIRING	Conduit, cables and circuits	A&E	CM	CM
6.02	ACTIVE EQUIPMENT - SMALL UNITS FOR WORK AREAS	UPS units in work areas	OWNER	OWNER	OWNER
6.03	ACTIVE EQUIPMENT - RACK MOUNTED UNITS	UPS units in racks	OWNER	OWNER	OWNER
7.00	FIRE ALARM AND BUILDING MANAGEMENT SYSTEM				
7.01	RACEWAYS & WIRING	Conduit, cables, patch panels, cable tray outlets, etc.	A&E	CM	CM
7.02	ACTIVE ELECTRONICS	Data gathering panels, sensors, etc.	A&E	CM	CM
8.00	DISTRIBUTED ANTENNA SYSTEM FOR LIFESAFETY				
8.01	RACEWAYS & WIRING	Conduit, cables, patch panels, cable tray outlets, etc.	VENDOR	VENDOR	VENDOR
8.02	INSIDE PREMISE WIRING	Cable , grounding	VENDOR	VENDOR	VENDOR
8.01	ACTIVE ELECTRONICS	Head end system and antennas	VENDOR	VENDOR	VENDOR

NOTES: A&E: PGAL ARCHITECTS AND ITS CONSULTANTS
 CM: CONSTRUCTION MANAGER
 S.P.: SERVICE PROVIDER

ATTACHMENT 3 – NETWORK CONNECTIONS PROGRAMMING PLAN

TLC ENGINEERING FOR ARCHITECTURE
NETWORK CONNECTIONS PROGRAMMING PLAN

PROJECT NAME						
DATE						
SUBCONTRACTOR						
TRADE						
TYPE OF DEVICES FORM (Fill one column per device type provided)						
DEVICES CHARACTERISTICS	DEVICE NAME DEVICE CODE	A	DEVICE NAME DEVICE CODE	B	DEVICE NAME DEVICE CODE	C
Manufacturer						
Part Number						
Firmware version						
Is a fixed address required or can device work with a dynamic address (DHCP)?						
Does device requires an address from a DNS server?						
Does device support Layer 3 traffic (IP)?						
Does device needs access to the internet?						
Number of physical network ports per device?						
Does device requires IPv6 to work or IPv4?						
Does device supports SNMP?						
Does device needs specific TCP ports open? Please list						
Is this device connecting to existing network devices (Yes/no)						
If yes to above, please describe to what device, located where.						

TLC ENGINEERING FOR ARCHITECTURE

NETWORK CONNECTIONS PROGRAMMING PLAN

PROJECT NAME	
DATE	

SUBCONTRACTOR	
TRADE	

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SECTION 270526**GROUNDING AND BONDING FOR TELECOMMUNICATIONS SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section.
- B. General: For grounding electrode system and equipment grounding system for Telecommunications refer to specification section 260526. In all cases the applicable electrical codes for grounding and bonding for telecommunications shall be met.
- C. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.
 - 1. 270010 Technology General Provisions
 - 2. 270528 Raceways for Technology
 - 3. 271000 Structured Cabling System
 - 4. 260526 Grounding and Bonding for Electrical Systems
- D. General. For a bonding diagram for telecommunications refer to T Drawings.
- E. General. The bonding approach required herein is intended to work in concert with the cabling topology as specified in Specification section 271000 and installed in accordance with specification section 270528.
- F. Reference Standards:
 - 1. TIA-607-B
 - 2. TIA-568-C
 - 3. TIA-606
 - 4. UL 1863 Communication Circuit Accessories
 - 5. UL-50 & UL-514
 - 6. NFPA 70 – NATIONAL ELECTRIC CODE
 - 7. IEEE Std. 1100-1992, Powering and Grounding Sensitive Electronic Equipment.
 - 8. BICSI TDMM, Telecommunications Distribution Method Manual.
 - 9. UL 1449
 - 10. NFPA 780

1.2 MATERIALS ALTERNATES AND SUBSTITUTIONS

- A. General: Substitutions are allowed for all components of the systems under this specification sections as long as all requirements for substitutions indicated in specification section 270010 are followed.

1.3 SHOP DRAWINGS AND SUBMITTALS

- A. See additional requirements for shop drawings and submittals in specification section 270010.
- B. The installer of the Telecommunications Grounding systems shall provide the following information in the shop drawings phase of the project:
 - 1. Manufacturer's cut sheets for all proposed equipment as described in Part 2 of this specification section. Cut sheets shall bear the printed logo or trademark of the manufacturer for each type of product being provided. Mark each copy of the data sheets for the specific product being provided with an identifying mark, arrow, or highlighting.
 - 2. A spreadsheet indicating telecommunications ground bar information selection for each telecommunications room indicated in the design drawings, including the following information:
 - a. Room Name or number
 - b. Quantity of ground bars
 - c. Height of each ground bar
 - d. Length of each ground bar
 - e. Number of holes in each ground bar
 - f. Label for each ground bar
 - 3. A drawing indicating the following information:
 - a. Location of all telecommunications ground bars and routing of all telecommunications grounding backbones.
 - b. Wire size charts for all telecommunications grounding backbones in the project.
 - c. All labels to be used in telecommunications backbone cables, bonding conductors and telecommunications ground bars.
 - 4. A detailed drawing layout of the MCBN for all spaces with raised floor in the project

1.4 ABBREVIATIONS

- A. General: The following abbreviations are used in this specification section:
 - 1. TBB - Telecommunications Bonding Backbone
 - 2. BC - Bonding Conductor

3. EMT - Electrical Metallic Tubing
4. RMC - Rigid Metal Conduit

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- A. The TMGB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TMGB shall be located and provided in the Main Telecommunication Room in each building. The TMGB must also be listed by a nationally recognized testing laboratory (NRTL).
- B. The TMGB shall have the following specifications:
 1. Material: Copper with a thin plated finish.
 2. Thickness: ¼" thick
 3. Width: No less than 4"
 4. Length: The installer of the grounding system shall estimate the length of the bar as to have enough pre-drilled holes for all BCs in the room. The bar shall be no less than 14" long. The installer shall follow the following criteria in estimating the amount of pre-drilled holes required in the TMGB:
 - a. Two holes required for each TBB termination.
 - b. Two holes for each cabinet or rack row in the room
 - c. Two holes for each protector block in the room
 - d. Two holes for each layer of ladder tray above the rack.
 - e. Two holes for each set of conduit sleeves entering the room
 - f. 20% of spare capacity shall be available after all terminations are done.
 - g. If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above.
 5. Pre-drilled holes: All pre-drilled holes shall have a diameter of 5/16"
 6. Hole spacing: All pre-drilled holes shall have a minimum spacing matching the spacing of the holes in the long barrel ground lugs.
- C. The TMGB shall be installed in the wall with stand offs and isolators. Isolators shall be rated at 600V.
- D. Approved manufacturers:
 1. Panduit,
 2. Erico or
 3. approved equal.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) FOR INTERIOR USE

- A. The TGB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TGB shall be located and provided in

each telecommunication room (except the main telecommunication room) in each building and any other additional locations as indicated in the drawings. The TGB must also be listed by a nationally recognized testing laboratory (NRTL).

B. The TMGB shall have the following specifications:

1. Material: Copper with a thin platted finish.
2. Thickness: 1/4" thick
3. Width: No less than 4"
4. Length: The installer of the grounding system shall estimate the length of the bar as to have enough pre-drilled holes for all BCs in the room. The bar shall be no less than 12" long. The installer shall follow the following criteria in estimating the amount of pre-drilled holes required in the TMGB:
 - a. Two holes required for each TBB termination.
 - b. Two holes for each cabinet or rack row in the room
 - c. Two holes for each protector block in the room
 - d. Two holes for each layer of ladder tray above the rack.
 - e. Two holes for each set of conduit sleeves entering the room
 - f. 20% of spare capacity shall be available after all terminations are done.
 - g. If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above.
5. Pre-drilled holes: All pre-drilled holes shall have a diameter of 5/16"
6. Hole spacing: All pre-drilled holes shall have a minimum spacing matching the spacing of the holes in the long barrel ground lugs.

C. The TMGB shall be installed in the wall with stand offs and isolators. Isolators shall be rated at 600V.

D. Approved manufacturers:

1. Panduit,
2. Erico or

2.3 FLEX CONDUCTOR, ONE-HOLE, LONG BARREL WITH WINDOW LUG

- A. All BCs (different from TBB) shall be terminated in a flex conductor, one hole, long barrel with window lug when a two hole connector is not possible to be used because receiving equipment does not support the two holes. All lugs shall be selected to match the size of the conductor being used. Other types of terminations such as screw type connectors are not accepted
- B. The flex conductor, one hole, long barrel with window lug shall have the following specification:
 1. Finish: Thin platted
 2. Cable types: designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors.

3. Stud hole size: ¼"
4. Barrel type: Long barrel > 1"
5. Termination type: crimp type
6. Angle: straight or angled if installation space is limited.
7. Listing: UL listed and tested to 35 KV and 90°C

C. Approved manufacturers: Panduit, Thomas & Betts or approved equal.

2.4 FLEX CONDUCTOR, TWO HOLE, LONG BARREL WITH WINDOW LUG

A. Flex conductors, two-hole, long barrel with window shall be used with TBB and BCs to provide a good bond. All lugs shall be selected to match the size of the conductor being used. Other types of termination are not accepted.

B. The flex conductor, two hole, long barrel with window lug shall have the following specification:

1. Finish: Thin platted
2. Cable types: designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors.
3. Stud hole size: ¼"
4. Hole spacing: to match spacing of pre-drilled holes in ground bar or equipment.
5. Barrel length: long barrel > 1"
6. Termination type: crimp type
7. Angle: straight or angled if installation space is limited.
8. Listing: UL listed and tested to 35 KV and 90°C

C. Flex conductors, two hole, long barrel with window shall be used with BCs in the following cases:

1. Bonding two sections of pathways such as sections of tubular runways or cable trays.
2. Bonding a BC or a TBB to a TGB or TMGB
3. Bonding to equipment that requires two holes for bonding.

D. Approved manufacturers:

1. Panduit,
2. Thomas & Betts or
3. approved equal.

2.5 HTAP CONNECTOR

A. When a BC is required to be bonded to another BC of same or different size the only approved method of bonding is with HTAP style crimp connectors. Screw type connectors, wire nuts or any other method are not acceptable. The specifications of the HTAP connectors are:

1. Finish: Thin platted
2. Cable types: designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors.
3. Tap grooves: installer to select HTAP connector based on size of BCs and quantity of BCs to be bonded.
4. Slots: The HTAP connector shall have a lot to support the unit to the bonding conductors with nylon cable ties for initial support before crimping.
5. Termination type: crimp type
6. Listing: UL listed and tested to 600V

B. Approved manufacturers:

1. Panduit,
2. Thomas & Betts or
3. approved equal.

2.6 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- A. Telecommunications bonding backbones shall be provided as indicated in the design documents. TBBs shall be insulated copper stranded conductors with a wire gauge dictated by the length of the cable. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum of 3/0 AWG. The following table shall be used to estimate the size of the TBBs:

TBB LENGTH LINEAR M (FT)	TBB SIZE (AWG)
Less than 4 (13)	6
5- 6 (14 – 20)	4
6 – 8 (21 – 26)	3
8– 10 (27 – 33)	2
10– 13 (34 – 41)	1
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0
Greater than 20 (66)	3/0

- B. Once a TBB has been sized with a particular gauge, any extensions of such backbone shall not be done with a wire gauge smaller than the previous run regardless of distance.

2.7 BONDING CONDUCTOR (BC)

- A. Bonding conductors shall be used to bond equipment and raceways to the telecommunications grounding infrastructure. The specifications of the BC are:
1. Conductor Size: use the chart above for TBB to estimate the size of the bonding conductor. BC shall be no smaller than an AWG-6. For projects with R56 Grounding compliance, BC shall be no smaller than AWG-2.

- 2. Material: copper stranded conductors.
- 3. Insulation: Use non-insulated conductors only under raised floor spaces. Insulation color shall be green with a yellow stripe.
- B. Pre-fabricated BCs or field made BCs are acceptable.
- C. Both ends of a BC shall be terminated in long barrel lugs.

2.8 LABELS FOR TELECOMMUNICATIONS GROUNDING INFRASTRUCTURE

- A. Installer shall follow labeling materials indicated in specification section 270010.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES.

- A. General: Specification section 260526 applies to work of this section. Installation requirements specified herein takes precedence over specification section 260526.
- B. General: All installation requirements indicated in specification section 270010 shall be followed.
- C. PROTECTION. The TBBs and BCs shall be installed and protected from physical and mechanical damage.
- D. GALVANIC CONTINUITY. The TBBs and BCs shall be continuous and routed in the shortest possible straight line path.
- E. CRIMPING. All lugs shall be crimped with the proper die for the size of lug being used.
- F. PAINT REMOVAL. Paint shall be removed before attaching any BC to an equipment with paint in the surface, such as ladder trays and racks, if no ground lug is available in the equipment.
- G. SPLICING. The TBBs and BCs shall be installed without splices. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located within telecommunications spaces. Joined segments of a TBB or BC shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.
- H. BONDING TO ELECTRICAL PANELS. The TGB or TMGB shall be as close to the electrical power panel as is practicable and shall be installed to maintain clearances required by applicable electrical codes. The electrical power panel bus or the panel enclosure feeding telecommunications equipment racks/cabinets shall be bonded to the TGB or TMGB.
- I. BONDING TO BUILDING STEEL. All connectors used for bonding to the metal frame of a building shall be listed for the intended purpose.

- J. LUG SCREWS. All connections from lugs to ground bars or grounding equipment shall be done with metal screws with nuts and compression washers. Connections made with metal self tapping screws will not be allowed.
- K. BONDING PROTECTOR BLOCKS. All primary or secondary building entrance protectors' blocks shall be bonded to the nearest TMGB or TGB with a BC. A minimum of 300 mm (1 ft) separation shall be maintained between this insulated conductor and any dc power cables, switchboard cable, or high frequency cables, even when placed in rigid metal conduit or EMT.
- L. BONDING OUTSIDE PLANT CABLES. When the outside plant cables in the Telecommunications Entrance Facility room incorporate a cable metallic shield (armor) isolation gap, the cable metallic shield on the building side of the gap shall be bonded to the TMGB or TGB or the rack/cabinet or the rack's vertical ground bar (if available).
- M. BONDING BACKBONE CABLES. Where backbone cables (fiber or copper) incorporate a shield (armor) or metallic member, this shield or metallic member shall be bonded to the TMGB or TGB or rack/cabinet or the rack's vertical ground bar (if available).
- N. BONDING HORIZONTAL CABLES. When shielded horizontal cable is used and terminated in patch panels, each patch panel needs to be bonded to the telecommunications grounding systems. A BC shall be used between each patch panel and the rack rails of the rack/cabinet or the rack's vertical ground bar (if available).
- O. INTENDED USE OF TBB OR BC. The TBB or BC is not intended to serve as the only conductor providing a ground fault current return path. The intended function of the TBB or BC is to equalize potential differences between telecommunications systems.
- P. INSTALLATION OF TBBs INSIDE TELECOMMUNICATIONS SPACES. When TBBs are run inside telecommunications spaces they shall be protected from damage by running them inside conduit. Conduit to protect TBBs inside telecommunications spaces can be made of PVC and shall be sized and supported as required by NEC.
- Q. INSTALLATION OF TBBs OUTSIDE TELECOMMUNICATIONS SPACES. When TBBs are run outside of telecommunications spaces they shall be protected from damage by running them inside conduit. Conduit to protect TBBs outside telecommunications spaces shall be EMT or RMC. To avoid an electromagnetic choke effect in this conductor, each end of the conduit used to protect the TBB shall be bonded to the TMGB or TGB at each end. Conduit used for protection of TBBs shall be sized and supported as required by NEC.
- R. RACK/CABINET BONDING. All racks/cabinets in the project shall be bonded to the nearest TMGB or TGB inside the room. All rows of rack/cabinets shall be bonded together by a single AWG-2 conductor coming from the nearest TMGB or TGB inside the room. This bonding conductor shall be insulated and run above the racks in the side of the cable tray system, going above the racks, supported by a hanger external to the cable tray. At each rack a bonding jumper (AWG-6) shall be provided and terminated to the rack manufacturer's recommended lug for bonding the rack/cabinet. The bonding jumper shall be connected to the AWG-2 conductor by means of an HTAP connector, protected with heat shrink material. When the project requires R56

grounding compliance, the bonding jumper shall be upsized to an AWG-2 and a vertical ground bar shall be provided for each rack/cabinet from top to bottom of each rack/cabinet. This ground bar shall be the termination point for the bonding jumper for each rack and shall also bond the manufacturer's approved grounding lug in the rack/cabinet to the ground bar.

- S. RACK/CABINET BONDING OUTSIDE OF TELECOM ROOMS. Racks/cabinets outside of telecom rooms shall be bonded to the nearest electrical ground with a BC.
- T. LABELING: All labeling systems for telecommunications grounding infrastructure shall be in compliance with the ANSI/TIA/EIA-606 standard. At a minimum, the following elements shall be labeled in the telecommunications grounding system:
 - 1. All TMGB or TGB, with a unique identifier located in the wall near the unit, not on the ground bar.
 - 2. All TBBs in the project with a unique identifier at each termination point of each TBB. The label in one side of the cable shall indicate the termination location of the other side of the cable.
 - 3. BC for rows of racks with a unique identifier at both ends of the cable
 - 4. BC for surge protectors with a unique identifier at both ends of the cable
- U. ADDITIONAL LABELING. All BCs bonding rows of racks/cabinets and TBBs shall have additional to the identification marker a yellow printed wrap around tag installed close to the bonding point strap to the cable jacket with a flame retardant cable tie. This tag shall have the following wording in green letters: "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".

3.2 AS BUILT DOCUMENTS AND CLOSE OUT INFORMATION

- A. See specification section 270010 for these requirements.

END OF SECTION 270526

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SECTION 270528

RACEWAYS FOR TECHNOLOGY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Section 260533 - Raceway Systems, apply to work of this Section. Specifications described herein take precedence over Section 260533.
- C. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.
 - 1. 270010 Technology General Provisions
 - 2. 270526 Grounding and Bonding for Telecommunications Systems

1.2 DESCRIPTION

- A. General: Furnish and install complete with all accessories a TIA 569 Pathways and Spaces infrastructure for supporting of Structured Cabling System (SCS) and housing of technology equipment. The goal of the project is to provide a reliable architecture of the building that shall serve as a support for transport of data, voice telephony, security and audio/visual cabling throughout the building from designated demarcation points to places located at various wall, floor, ceiling, column, room and other locations as indicated on the contract drawings and described herein. The cabling that shall be supported includes, but is not limited to:
 - 1. Copper - UTP 4PR CAT plenum or Non-plenum cable, Multipair CAT plenum and Non-plenum, Multipair telephone general purpose plenum and Non-plenum, RJ45 Patch Panel
 - 2. Panels and Jacks, 110 Punch down blocks, 66 Punch down blocks, Wire management devices.
 - 3. Fiber Optic - Air blown Fiber cables, Conventional fiber optic cables. Fiber distribution and Termination Cabinets.
 - 4. Other: Hybrid Cables, Composite cables, Floor Racks and cabinets, Wall mounted racks and cabinets.
 - 5. The equipment that shall be housed includes, but are not limited to:
 - a. Voice Telephony - PBX
 - b. Data - Hub, Switch, Router, Modem, Repeater, Transceiver, DSU/CSU.
 - c. Other: Multiplexer, Multipurpose switch, UPS

- d. Security head end equipment
 - e. Audio/visual system
- B. General: For pathways the system shall utilize a combination of conduit, cable tray and supports for vertical and horizontal cabling support. Pathways shall be provided and located as shown and in the quantities indicated on the drawings. Pathways shall terminate in rooms or closets using approved fasteners and termination hardware and bushings and shall be reamed to eliminate sharp edges. All Pathways shall be identified at all locations.
- C. All installers should anticipate that all products and installation procedures shall comply with the ANSI/TIA/EIA-569-A (CSA T530) requirements at a minimum.
- D. General: Installation of the raceways for communications shall be a complete system including all supports and hangers as required per contract documents and manufacturer's installation guidelines.
- E. Support: All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels. Do not install any devices supported by ceiling tiles.
- F. Installation: The Installer shall layout and provide his work in advance of the laying of floors or walls, and shall provide all sleeves that may be required for openings through floors, walls, etc. Where plans call for conduit to be run exposed, provide all inserts and clamps for the supporting of conduit.
- G. Pull Strings: Provide pull strings in all raceways. Pull strings shall be nylon and shall be impervious to moisture. Pull strings installed in one (1) inch and smaller conduits shall have a tensile strength of not less than 30 lbs. Pull strings installed in conduits larger than one (1) inch shall have a tensile strength not less than 200 lbs.
- H. Directional boring might be required in the drawings or the installer might choose this method as the way to install underground conduit on this project. In either case, the installer shall comply with the requirements indicated here for directional boring.
- I. If at the time of bid and underground locate survey is not available, the installer shall include in the pricing the cost of this survey. No directional boring will be allowed without such survey being completed.

1.3 INSTALLER QUALIFICATIONS

- A. General: The installer selected for the Project must be BICSI certified installer and certified by the manufacturer for the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning the Project.
- B. General: The Installer directly responsible for this work shall be a " Pathways and Spaces for Structured Cabling System Installer (PS-SCS) " who is, and who has been, regularly engaged in the providing and installation of commercial and industrial pathways and spaces for telecommunications wiring systems of this type and size for at least the

immediate past five years. Any sub-Installer who will assist the PS-SCS installer in performance of this work, shall have the same training and certification as the PS-SCS installer.

- C. Certification: The installer's Project Manager shall possess a current and in good standing BICSI Registered Communications Distribution Designer (RCDD) certificate. All shop drawings submitted by the installer shall bear the RCDD's seal.
- D. Experience: The Installer shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Installer shall own and maintain tools and equipment necessary for successful installation and have personnel who are adequately trained in the use of such tools and equipment.

1.4 MATERIALS ALTERNATES AND SUBSTITUTIONS

- A. General: Substitutions are allowed for all components of the systems under this specification sections as long as all requirements for substitutions indicated in specification section 270010 are followed.

1.5 SHOP DRAWINGS AND SUBMITTALS

- A. See additional requirements for shop drawings and submittals in specification section 270010.
- B. General: The PS-SCS installer shall provide no later than 30 days after contract award the following information:
 - 1. Proof of Installer's qualifications per paragraph 1.03.
 - 2. Cut sheets of all products to be used for the project, highlighting in particular the precise product to be used in each case, when multiple devices are indicated in the cut sheet. At a minimum the following devices shall be submitted with this specification section:
 - a. Supporting devices (j-hooks) if allowed in the project. See part 3 of this specification.
 - b. Cable tray system with accessories
 - c. Runway cable tray system with accessories.
 - d. Plywood
 - e. Trough wall/floor firestop system
 - f. Innerduct
 - g. Detectable tape
 - h. Communications vaults
 - i. Conduit waterfalls
 - j. Fire stop system (for small penetrations)
 - 3. Drawings indicating precise location and type of all support for cable tray or ladder tray systems in all areas where they will be used.
 - 4. For all communication vaults, drawings shall be prepared indicating conduit penetrations on each side of each vault. Vaults shall be labeled to indicate their correct location in the site plan.

5. Pre-cast communications vaults shall be submitted with load calculations signed and sealed by a professional engineer.
6. For any directional boring runs, the installer shall provide a drawing indicating all underground locate surveys and the proposed routing of the conduit as well as proposed depth.

1.6 WORK EXTERNAL TO THE BUILDING

- A. General: Any work external to the confines of this building as shown on the drawings shall be governed by provisions of this specification.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. All conduits as indicated in Section 26

2.2 WIREWAYS

- A. General: Wireway shall be sized as shown on drawings, NEMA 1, lay-in type. Wireway sides and bottom shall contain no knock-outs unless shown otherwise on the drawings. The Installer shall punch holes required. The cover shall be hinge type with quarter turn fasteners to hold cover shut. Covers and bodies shall be 16 gauge steel. Wireway shall be as manufactured by Hoffman Engineering Company, Square "D" or Steel City.

2.3 SUPPORTING DEVICES

- A. Hangers: Hangers shall be made of durable materials suitable for the application involved. Where excessive corrosive conditions are encountered, hanger assemblies shall be protected after fabrication by galvanizing, or approved suitable preservative methods.
- B. Non-continuous cable supports (j-hooks) shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; UL Listed.
- C. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
- D. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
- E. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
- F. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.

- G. Anchoring: Insert anchors shall be installed on concrete or brick construction, with hex head machine screws. Recessed head screws shall be used in wood construction. An electric or hand drill shall be used for drilling holes for all inserts in concrete or similar construction. Installed inserts, brick, shall be near center of brick, not near edge or in joint. Drilled and tapped, and round head machine screws shall be used where steel members occur. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from rust-resisting metal, or accepted substitution. Gunpowder or lead set anchors are not permitted.
- H. Accessories: Non-continuous support systems shall be provided with the adequate mounting accessories depending on the location where the support will be installed, like beam clips, flange clips, C and Z purlin clips.
- I. Accepted manufactures; Erico or Panduit.

2.4 TUBULAR RUNWAY CABLE TRAY AND FITTINGS

- A. Materials: ASIM A36 steel bar.
- B. Finish: Baked Powder painted surface treatment using Polyester coating.
- C. Finish color: to match equipment cabinet finish color. See specification section 271000.
- D. Cable management tray width: as shown on the drawings.
- E. Fittings: Cable management fittings and hardware recommended by Manufacturer. Provide drop-off, 90° and tees as required for the equipment served and support of the cable. Provide at least one large radius drop off for each rack/cabinet in the project.
- F. Installation: Cable management system to be installed using support components as recommended by the Manufacturer.
- G. Loading: Cable management system to be installed and supported per Manufacturer's suggested span load criteria.
- H. Approved Manufacturers: B-line, GS Metals, Chatsworth.

2.5 PLYWOOD BOARDS IN TELECOMMUNICATION ROOMS

- A. Plywood Backboard: Backboards shall be installed in each TR and the MTR on walls to a height of 8' AFF or as shown on the drawings. Rooms shall have walls covered as shown on the drawings. Plywood shall be $\frac{3}{4}$ " AC Grade with the best side out. All imperfections and voids shall be filled, sealed and sanded prior to being primed and painted with two (2) coats of UL Classified, fire retardant intumescent paint on the front, back and all four sides of the plywood. Fire retardant coating shall be tested to UL723, "Test for surface burning characteristics of building materials." Color to be grey, white or blue. Coordinate color selection with the Owner/Architect. Backboards shall be clearly labeled with the name of the Backboard Manufacturer, UL Classification of the Fire Retardant Coating, NFPA 255 Coating Flame Spread Index Class and the APA Grade of the plywood.

- B. Design Selection: Series Pathways & Spaces, Inc. ReadySpec Series or equal, field fabricated backboards to all of the specifications listed above for "plywood backboards". All voids shall be filled and sanded smooth, prior to applying 1 coat of primer, and two coats of UL Classified Fire Retardant paint. The installer shall provide proof that 3/4" AC Grade Plywood and UL Classified paint was used in making the backboards. Furthermore, the installer shall provide verification that all backboards were primed, and painted on all sides (front, back and all sides) with two coats of the required paint. Proof of compliance shall be submitted upon project completion as part of the closeout documentation.
- C. Terminal Board Conduits: Conduits at Terminal board locations shall be neatly racked on a Kindorf Type rack secured to wall above and below terminal boards.

2.6 THROUGH WALL/FLOOR FITTING FIRE STOP SYSTEM

- A. General. These devices covered under this specification are firestop devices for use in through-penetration firestop systems, which are used to maintain the fire rating of the wall or floor, as well as to route and protect power and/or communications cable distribution for commercial, educational, healthcare, government, institutional, industrial and utility needs.
- B. Classification and use: The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. and Canadian UL Classification Mark. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls and provide a maximum L rating of 3.3 cfm. The device shall be classified for use in one-, two-, and three-hour rated concrete floors having a minimum 4 1/2" (114mm) thick reinforced lightweight or normal weight (100-150 pcf) (1600-2400 kg/m3). The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.
- C. Materials:
 - 1. Box: The fire stop device box shall be constructed of 16 gage G90 steel.
 - 2. Intumescent block: The fire stop device intumescent block shall be constructed of a graphite base material with expansion starting at 375° F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
 - 3. Adjustable doors: the fire stop device shall have doors or other system which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16 gage G90 steel with no. 10-32 screws use to adjust opening size.
 - 4. Heat shield: For retrofit applications where an existing in-wall conduit extends out from the wall more than 7/8" [22mm], a UL listed Heat Shield must be used in order to maintain UL Fire Classification. The firestop device is then installed onto the heat shield
 - 5. Split conduit and wall plate: For retrofit applications where no conduit is installed in the wall to protect existing cables, a split conduit assembly should be used to protect cables. After installing the split conduit within the wall, a wall plate should be installed to cover any irregularly shaped hole cut in the wall. The firestop device is then installed onto the conduit.

- D. Sizes: the fire stop device shall be available for two (2) inch and four (4) inch trade size emt conduit.
- E. Finish: the fire stop device shall be available in safety yellow or orange powder coat, custom colors and an unpainted galvanized finish.
- F. Design selection: Wiremold FlameStopper, STI EZpath or approved equal

2.7 INNERDUCT (REGULAR)

- A. Flexible raceway system also referenced in the design documents as regular innerduct or innerduct shall be provided in locations indicated in design drawings. The innerduct type shall be selected according to the environment where it will be installed, use HDPE innerduct only outdoors, use plenum or riser rated innerduct indoors. The installer is responsible for determining the proper selecting of the innerduct when used in air handling spaces. If at the time of bidding the installer is not sure what kind of environment is present in the project, the installer shall price plenum rated materials.
- B. For plenum rated applications, the specifications of the innerduct shall be:
 - 1. Material: White or orange Kynar PVDF Resin, a fluoropolymer compound.
 - 2. Listing: Innerduct shall be listed to UL 224, listing shall be printed in the product.
 - 3. Marking: Footage shall be sequentially marked.
 - 4. Configuration: corrugated type.
 - 5. Pull line: built in 900 lb rated tape.
 - 6. Size: Shall be available in 3/4" through 2" diameters.
- C. For riser rated applications, the specifications of the innerduct shall be:
 - 1. Material: Orange polyvinyl chloride (PVC).
 - 2. Listing: Innerduct shall be listed to UL 224, listing shall be printed in the product.
 - 3. Marking: Footage shall be sequentially marked.
 - 4. Configuration: corrugated type.
 - 5. Pull line: built in 900 lb rated tape.
 - 6. Size: Shall be available in 3/4" through 2" diameters.
- D. For outdoor applications, the specifications of the innerduct shall be:
 - 1. Material: High Density Polyethylene (HDPE).
 - 2. Listing: None.
 - 3. Marking: Footage shall be sequentially marked.
 - 4. Configuration: corrugated type.
 - 5. Pull line: built in 1,800 lb rated tape.
 - 6. Size: Shall be available in 3/4" through 2" diameters.
- E. All inner ducts shall be provided with couplings and accessories suitable for the environment where they will be installed.
- F. Design selection: products by Carlon or approved equal.

2.8 CONDUIT WATERFALLS

- A. All 4" EMT terminations with communication cable entering/exiting the conduit from a cable tray (or tubular runway) system and the vertical separation between raceways is larger than 7" shall be fitted with a device to control the bend radius of the communication cable to a minimum of a 4" radius. The device to control the bend radius shall be called a conduit waterfall and must comply with all National Electrical Code requirements and TIA/EIA Standards. In addition, the product must be RoHS compliant to meet environmental requirements, be UL 94V-0 approved to reduce the spread of flame, and be approved by UL for use in air handling spaces. The device to provide bend radius control must support a static load of 40 lbs. (177.9 N) and have a fastening device that allows for incremental adjustments to conform to variances in conduit diameters.
- B. Device quantities are not indicated in the drawings but the PS-SCS shall use all 4" conduits and sleeves indicated in the drawings to estimate the quantities of waterfalls to be used in the project.
- C. Basis of design: Panduit CWF 400 or approved equal.

2.9 FIRE STOP SYSTEMS (FOR SMALL PENETRATIONS)

- A. General: Fire stop system shall be selected by the PS-SCS installer as to comply with the following requirements:
 - 1. Selected system shall be UL listed for the condition on which it will be installed. These conditions include: wall/slab type (masonry, drywall, etc), hour rating, and accessibility type.
- B. Acceptable systems: caulk based products or firestop grommets by STI or equal.

2.10 EXPANSION FITTINGS

- A. Installation: Provide expansion fittings in each conduit run wherever it crosses an expansion joint. Install the fitting on one side of the joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints.
- B. Location: Provide expansion fittings in each conduit run which is mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other.
- C. Length: Provide expansion fittings in straight conduit runs above ground which are more than one hundred (100) feet long.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

- A. See additional requirements indicated in part 3 of specification section 270010.

3.2 INDOOR CONDUITS BELOW GRADE AND ABOVE GRADE

- A. BEND RADIUS. Conduits shall utilize long radius sweeps at all 90 degree transitions. The inside radius of a bend in conduit shall be at least six (6) times the internal diameter. When the conduit size is greater than two (2) inches, the inside radius shall be at least ten (10) times the internal diameter of the conduit. For fiber optic cable, the inside radius of a bend shall always be at least ten (10) times the internal diameter of the conduit
- B. MAXIMUM DISTANCE BETWEEN JBOXES. For indoor installation no section of conduit shall be longer than one hundred (100) ft or contain more than two (2) 90 degree bends between pull points or pull boxes are required. For outdoor installation no section of conduit shall be longer than six hundred (600) ft or contain more than two 90 degree bends between pull points or pull boxes are required.
- C. LABELING. All indoor conduits 2" or larger shall be labeled at both ends when these conduit runs are continuous between two rooms and going through multiple walls or slabs. Labeling materials shall be as indicated in specification section 270010. Conduit sleeves 2" or larger penetrating just one wall is not required to be labeled.
- D. PULL STRINGS; All conduits for technology systems shall be installed with pull strings.

3.3 CUTTING AND PATCHING

- A. Core Drilling: The installer shall be responsible for all core drilling as required for work under this section, but in no case shall the installer cut into or weld onto any structural element of the project without the written approval of the A&E. Any post tension slabs or slabs with embedded electrical raceways shall be X-rayed prior to coring by the installer.
- B. Cutting and Patching: All cutting, rough patching and finish patching shall be provided as specified in the contract documents. All cutting and patching shall be performed in a neat and workmanlike manner.
- C. Openings and Sleeves: Locate all openings required for work performed under this section. Provide sleeves, guards or other accepted methods to allow passage of items installed under this section.
- D. Roof Penetration: All roof penetrations for raceways part of technology systems shall be approved by A&E prior to executing this work. All roof penetrations shall be as accepted by the roof manufacturer.

3.4 IDENTIFICATION OF BOXES

- A. Tags: During installation of pull strings all pull strings shall be marked with waterproof vinyl tags indicating where the opposite end may be found.

3.5 BLANK PLATES

- A. Plates: Unless otherwise noted all unused outlet boxes shall receive blank plates matching the finish of plates for electrical devices in the same room.

3.6 RACEWAY INSTALLATION

- A. **SUPPORT.** All raceways shall be run in a neat and workmanlike manner and shall be properly supported and in accordance with the latest edition of the NEC code and BICSI guidelines. Supporting conduit and boxes with wire is not acceptable. Exposed raceways where allowed, shall be supported with clamp fasteners with toggle bolt on hollow walls, and with no lead expansion shields on masonry. All conduits shall be securely fastened in place with at least one support per eight foot section. Support within one foot of changes in direction. All required hangers, supports and fastenings shall be provided at each elbow and at no more than one foot from the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits shall not be permitted. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp-backs, or other accepted devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.
- B. **HANGER INSTALLATION.** Where two (2) or more conduits one (1) inch or larger run parallel, trapeze hangers may be used consisting of concrete inserts, threaded solid rods, washers, nuts and galvanized "L" angle iron, or Unistrut cross members. These conduits shall be individually fastened to the cross member of every other trapeze hanger with galvanized cast one hole straps, clamp backs, bolted with proper size cadmium machine bolts, washers and nuts. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a conduit run and at each elbow. J-bolts, or approved clamps, shall be installed on each third intermediate trapeze hanger to fasten each conduit.
- C. **NON-CONTINUOUS CABLE SUPPORTS INSTALLATION.** Install non-continuous cable supports (j-hooks) only as recommended by manufacturer not exceeding the load ratings of the devices. Install non-continuous cable supports in spans no longer than 4'. Whenever there are changes in elevation additional supports shall be required to avoid having stress on cable or sharp bends.
- D. **FIRE STOPPING:** For 4" sleeves, the PS-SCS installer shall provide through wall/floor fittings firestop system and for other smaller sleeves or wall penetrations through fire rated partitions the PS-SCS installer can use the same type of firestop system or a fire stop system for small penetrations in compliance with products described in part 2 of this specification.
- E. **PENETRATIONS IN FIRE RATED PARTITIONS.** Installation of electrical boxes or equipment backboxes in fire rated walls and smoke barriers shall follow the following requirements:
1. Electrical boxes and or technology system backboxes can be installed in 1 or 2 hour rated walls as long as all requirements indicated in the proper Building Code, National Electrical Code and nationally recognized testing laboratories are met for this type of installation. In Florida, see Section 713 of the Florida Building Code 2010, article 300.21 of the NEC 2010 and UL database website for acceptable product to be used.
 2. As a summary, some of the requirements indicated by the codes listed above are:
 - a. Boxes shall be metallic or listed for that purpose

- b. The area of the boxes shall not exceed 16 square inches, provided the aggregate area of the openings through the membrane does not exceed 100 square inches in any 100 square feet of wall area.
 - c. The spacing between the wall membrane and the box shall not exceed 1/8 of an inch.
 - d. Boxes on opposite sides of the walls shall be separated by no less than 24 inches, or boxes shall be covered by listed putty pads, or a listed material and method used.
 - 3. Electrical boxes or technology systems backboxes shall not be installed in a 3 or 4 hour fire rated walls.
- F. ROUTING: Conduits shall be run parallel to building walls wherever possible, exposed or concealed as specified, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.
- G. PROTECTION DURING CONSTRUCTION. All raceway runs, whether terminated in boxes or not, shall be capped during the course of construction until wires are pulled in and covers are in place. No conductors shall be pulled into raceways until the raceway system is clean and complete.
- H. PROTECTIVE BUSHINGS: All un-terminated conduits shall have an insulated protective bushing to avoid cable damage at the edge of the conduit.
- I. AVOIDING EMI: To avoid EMI for Telecommunications cabling and/or conduit containing cabling, all raceways shall provide clearances of at least four (4) feet (1.2 meters) from motors or transformers; one (1) foot (0.3 meter) from conduit and cables used for electrical-power distribution; and five (5) inches (12 centimeters) from fluorescent lighting. Raceways shall cross perpendicular to fluorescent lighting and electrical-power cables and conduits. The Installer shall not place any raceway alongside power lines
- J. COORDINATION. All raceways shall be kept clear of mechanical equipment and plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.
- K. MASONRY INSTALLATION. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.
- L. USE OF CONDUIT IN DIFFERENT AREAS. When low voltage cables (any technology system) have to be run above ground in a space with no type of accessible ceiling (interior or exterior), all cable runs shall be in conduit completely, continuing the raceways all the way to the nearest accessible ceiling (in the direction of the telecom closet) or grouping the raceways into a single larger diameter conduit with the same or larger cross sectional area than the sum of all the conduits coming into it. The use of j-hooks to support low voltage cables in areas with no ceiling or hard ceiling shall not be allowed. This type of condition is usually not indicated in the drawings because design drawings don't show conduits smaller than 2", nevertheless it shall be provided as indicated herein.
- M. USE OF CONDUIT FOR DIFFERENT SYSTEMS: The following paragraphs indicate the design intent for raceways system for all technology systems.

1. For all systems under division 27: Conduit stub up from the outlet to the nearest accessible ceiling, non-continuous support system to the nearest cable tray system or telecommunications room.

3.7 TUBULAR RUNWAY CABLE TRAY SYSTEM INSTALLATION

- A. General. Runway cable tray system shall be installed following manufacturer's recommendations for installation.
- B. Support locations: supports shall be provided as recommended by the manufacturer, but as a minimum supports shall be located as follows:
 1. Before each 90 deg turn.
 2. No continuous section shall have more than 3ft of span without a support..
 3. At each 2-post rack or 4-post rack
 4. At each change in elevation
- C. Support type. When runway cable tray is to be installed against the wall, the only support type to be used is a wall bracket supporting from the bottom of the tray. For sections of runway cable tray to be installed over racks, the preferred support system is to the racks themselves. Trapeze style support brackets shall only be used when no other method of support is possible.
- D. Vertical runways. Runway cable tray system shall be installed continuously vertically in all telecommunications rooms in the project from sleeves coming from the ground (or floor below) to the sleeves going to the floor above, whether or not indicated in the drawings. The runway installed shall have the same width as the total width of the sleeves coming into the telecommunications room, although multiple sections installed together are acceptable. If the sleeves from the floor below to the floor above don't line up in a straight line, two vertical sections are accepted, one to the horizontal runway cable tray and one from the horizontal runway cable tray to the sleeves above. Runway cable trays installed vertically shall have supports to the floor, wall and slab above.
- E. Cable dropout. At each rack or cabinet that has runway cable tray system running on top of it, a cable dropout shall be installed to protect the bend radii of the cable. This dropout accessory shall have a bend radius of no less than 4".
- F. Bonding. Any two continuous sections of runway cable tray system shall be bonded together with a #1 bonding jumper (600A) 15" long. All bonding jumpers shall be made of steel with yellow, zinc-dichromate finish. All fasteners shall be made of steel with zinc-plated finish
- G. Protective end caps. All end sections of runway cable tray sections shall be protected with plastic protective end caps.

3.8 INSTALLATION OF INNERDUCT

- A. Protect products from the effects of moisture, UV exposure, corrosion and physical damage during construction.

- B. When inner duct is laid on a cable tray, it shall be strapped to cable tray with nylon ty-wraps at periodic intervals of no less than 4 ft.
- C. When multiple inner duct are in a single conduit, and innerduct are of the same size, they shall be different colors for identification or have different color electrical taped wrapped on the ends to identify them at the end of each conduit.

3.9 AS BUILT DOCUMENTS AND CLOSE OUT INFORMATION

- A. See specification section 270010 for as built documents and close out information these requirements.

END OF SECTION 270528

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SECTION 271000

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. General: Telecommunications Drawings apply to work of this section. The overall and detailed Structured Cabling System (SCS) design shown on the drawings, selected materials, device locations, installation details, mounting details, cabling routing and supporting and all technical specifications if provided on the drawings apply to work of this section.
- B. General: Furnish, install, test and certify complete with all accessories an ANSI/TIA 568C SCS with a minimum 25 year performance warranty for the entire system from the manufacturers and a minimum of 3 years warranty for materials and labor from the SCS installer for all components not covered under the manufacturer's 25 year warranty. The goal of the project is to provide an enhanced SCS that shall serve as a vehicle for the transport of voice telephony, data, audio, video, security and low voltage devices for building controls and management, throughout the building and from building to building from designated demarcation points to outlets located at various desk, workstation and other locations as indicated in the contract drawings.
- C. Coordination with other trades: It is the responsibility of the installer of the SCS to verify and advise the installer of the raceway infrastructure (conduit, boxes, cable tray, in ground boxes, etc.) for this system on raceway routing to minimize the wiring distances to the telecommunication room. When J-hooks are acceptable for the use in structured cabling system, all J-hooks and supports for these devices shall be in the scope of work of the SCS installer.
- D. All patching and cross connect to owner provided equipment shall be included under the scope of work of this project.
- E. During the execution of the work, all required relocation, demolition, temporary connections, rerouting, etc., of existing cabling, equipment and systems in the existing building areas where the work is required, shall be performed by the SCS installer, as indicated on the drawings, or as required by job conditions and as determined by the Architect in the field, to facilitate the installation of the new systems. The Owner shall require continuous operation of the existing systems, while demolition, relocation work or new tie-ins are performed.

1.2 RELATED DOCUMENTS

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section

- B. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section:

SECTION	TITLE
270010	TECHNOLOGY GENERAL PROVISIONS
270528	RACEWAYS FOR TECHNOLOGY
270526	GROUNDING & BONDING FOR TELECOMMUNICATIONS SYSTEMS

- C. Owner standards: Comply with the document "Requirements for all Communication Cabling at Clients name" prepared by the Clients applicable office.
- D. Standards: All work related to the SCS shall be in compliance with the following industry codes and standards latest edition:
1. ANSI/TIA-568-C.0 "Generic Telecommunications Cabling for Customer Premises" with addendums and errata.
 2. ANSI/TIA-568-C.1, "Commercial Building Telecommunications Cabling Standard" with addendums and errata.
 3. TIA-568-C.2, "Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted- Pair Cabling Components" with addendums and errata.
 4. ANSI/TIA-568-C.3, "Optical Fiber Cabling Component Standard" with addendums and errata.
 5. TIA-569-C: "Telecommunications Pathways and Spaces" with addendums and errata.
 6. ANSI/NECA/BICSI 568-2006, "Standard for Installing Commercial Building Telecommunications Cabling".
 7. TIA-606-B, "Administration Standard for Telecommunications Infrastructure" with addendum and errata.
 8. TIA-607-B "Commercial Building Grounding (Earthing) and Bonding requirements for Telecommunications" with addendum and errata.
 9. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.
 10. TIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant". December 2008
 11. TIA-526-14B "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant". October 2010.
 12. TIA-598-C. Optical Fiber Cable color coding. .
 13. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments. "Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling"
 14. ANSI/TIA-942-A , "Telecommunications Infrastructure Standard for Data Centers" with addendum and errata
 15. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 16. ANSI/NFPA 70 "National Electrical Code", CSA C22.1.
 17. BICSI Telecommunications Distribution Methods Manual (TDMM)
 18. BICSI Telecommunications Cabling Installation Manual (TCIM)
 19. BICSI Customer Owned Outside Plant Manual (COOPM)
 20. Local County/City Codes, Ordinances and Regulations.
 21. Underwriters Laboratories (UL)
 22. FCC -Federal Communications Commission

23. ADA Requirements
24. Occupational Safety and Health Regulations (OSHA)
25. National Fire Protection Association (NFPA)
26. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standards
27. Florida Statutes and Administrative Rules
28. Manufacturers Product Cabling Catalogs
29. Manufacturers Training Manuals (Design and Installation).

- E. General: Installation practices for SCS as describe herein take precedence over any other section in the construction documents set.

1.3 STRUCTURED CABLING SYSTEM INSTALLER QUALIFICATIONS

- A. General: The installer selected for the project must be certified by the manufacturers of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturers components and distribution channels in provisioning the Project.
- B. General: The installer directly responsible for this work shall be a Structured Cabling System (SCS) Installer who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years. Any other company working for the SCS installer of this system shall have the same training and certification as the SCS installer.
- C. Certification: The SCS installer's Project Manager shall possess a current and in Good Standings BICSI Registered Communications Distribution Designer (RCDD®) certificate. All shop drawings submitted by the SCS Installer shall bear the RCDD's stamp.
- D. The SCS Installer shall have a (BICSI) RCDD on Staff. Third party RCDD's shall not be acceptable.
- E. The Installer team leader assigned for the project shall be BICSI registered Level II installer or proven and qualified equal.
- F. Experience: The SCS Installer shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The SCS Installer shall own and maintain tools and equipment necessary for successful installation and testing of SCS and have personnel who are adequately trained in the use of such tools and equipment. The Owner or engineer may elect to request submittal of additional financial, operational and administrative information of the SCS installer to demonstrate the required experience.
- G. The SCS Installer shall possess a State of Florida Low Voltage License.
- H. The SCS Installer shall maintain a permanent office within 150 miles of the project site.

1.4 MATERIALS ALTERNATES AND SUBSTITUTIONS

- A. SCS Installer shall follow all requirements for materials alternates and substitutions indicated in specification section 270010.
- B. Substitutions are only allowed for the SCS when the substitutions do not change the warranty of the SCS system as indicated in this specification section

1.5 SHOP DRAWINGS AND SUBMITTALS.

- A. See additional requirements for shop drawings and submittals in specification section 270010.
- B. Proposal Submittals: The SCS Installer shall submit the following information with the proposal to execute the work:
 - 1. A list of five (5) recently completed projects of similar type and size with contact names and telephone numbers for each.
 - 2. A list of test equipment proposed for use in verifying the integrity of the installed SCS. Test equipment list shall include manufacturer part number, serial numbers and a copy of the last calibration report done by the manufacturer of the equipment of the unit, indicating the date when the calibration was done. Calibrations shall not be older than one year. Test equipment includes, cable certifiers, OTDRs, fiber splicers, etc.
 - 3. A technical resume of experience for the installer's engineer/RCDD and on-site foreman who will be assigned to the project, including RCDD license number.
 - 4. Similar documentation for any company working for the SCS Installers who will assist in the performance of this work.
 - 5. A copy of a current and valid Low voltage License for the State of Florida.
 - 6. Location of office from which installation and warranty work will be performed.
- C. Construction submittals: Once all proposal submittals have been received and approved by the Architect and Engineer (A&E) of the project, the SCS Installer shall provide all construction submittals. Construction submittals are composed of the following items.
 - 1. Manufacturer's cut sheets for all proposed equipment as described in Part 2 of this specification section. Cut sheets shall bear the printed logo or trademark of the manufacturer for each type of product being provided. Mark each copy of the cut sheets for the specific product being provided with an identifying mark, arrow, or highlighting.
 - 2. Faceplate color selection.
 - 3. Detail explanation of the labeling scheme to be used for all components of the system. This explanation shall include examples of all types of labels to be used, like labels for cables, patch panels, outlet jacks, etc.
 - 4. Autocad® or Revit drawings in sheets matching the size of the design documents with the following information:

- a. Floor plans with all outlets in the project. All outlets shall have the label to be used during identification and tagging process described in this specification section.
 - b. Enlarged telecommunication rooms with all equipment components and rack layouts for each room. All racks shall have the label to be used during identification and tagging process described in this specification section.
 - c. Drawings indicating rack elevations for all cabinets or racks in the project, identifying the precise quantity of patch panels, fiber distribution centers and wire managers and accurate RU heights based on equipment selection. All equipment shall have the label to be used during the identification and tagging process described in this specification section.
 - d. A spreadsheet indicating all patch cords (fiber and copper) to be provided in the project. The spreadsheet shall indicate the quantity, color of the jacket, cable type, length and connector termination on each side.
- D. Construction submittals received before proposal submittals are received or approved will be rejected.

1.6 ABBREVIATIONS

- A. General: The following abbreviations are used in this specification section:
- 1. A&E - Architect and Engineer. The Architect is the legal entity that holds a contract for the design the project. The Engineer is the consulting engineer firm or engineer of record for the project who prepared this specification.
 - 2. APC - Angle physical contact connector. Reference to the polish style of the ferrule in fiber optic connectors.
 - 3. Array connector - a multi-strand fiber connector user for high density applications, such as the MPO connector
 - 4. BICSI - Building Industry Consultant Services International
 - 5. CCTV - Close circuit television system (surveillance video system)
 - 6. FCC - Federal Communications Commission.
 - 7. FTP - Foiled Twisted pair. One foiled screen around each cable pair.
 - 8. IDC - Insulation Displacement Connector
 - 9. NEC - National Electrical Code.®
 - 10. NEMA - National Electrical Manufacturers Association.
 - 11. OM1 - ISO 11801 designation for multimode 62.5/125µm glass fiber optics.
 - 12. OM2 - ISO 11801 designation for multimode 50/125µm glass fiber optics.
 - 13. OM3 - ISO 11801 designation for multimode laser optimized 50/125µm glass fiber optics.
 - 14. OM4 - TIA designation for multimode laser optimized 50/125µm glass fiber optics in compliance with TIA-492-AAAD.
 - 15. OS1 - ISO 11801 designation for single mode 9/125µm glass fiber optics.
 - 16. OS2 - ISO 11801 designation for single mode 9/125µm glass fiber optic with performance criteria identical to ITU-T G652.
 - 17. OTDR - Optical Time Domain Reflectometer.
 - 18. RU - Rack units. Height dimension for rack mounted equipment. 1 RU equivalent to 1.75".
 - 19. SCS - Structured Cabling System
 - 20. ScTP - Screened twisted pair. One foiled screen around all cable pairs

- 21. TIA - Telecommunications Industry Association.
- 22. TR - Telecommunications Room.
- 23. UPC - Ultra physical contact connector. Reference to the polish style of the ferrule in fiber optic connectors.
- 24. UTP - Unshielded twisted Pair
- 25. UV - Ultra violet
- 26. VAC - Volts alternating current.

PART 2 - PRODUCTS

2.1 MODULAR SCS JACKS

- A. Structured cabling system outlets indicated in design drawings are composed of modular SCS jacks, mounted in a faceplate on an electrical box. Modular SCS jacks shall be 8-pin modules (RJ-45) that meet or exceed the following electrical and mechanical specifications:
 - 1. Electrical Specifications:
 - a. Insulation resistance: 500 M Ω minimum.
 - b. Dielectric withstand voltage 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
 - c. Contact resistance: 20 M Ω maximum.
 - d. Current rating: 1.5 A at 68 ° F (20 ° C) per IEC publication 512-3, Test 5b
 - e. ISO 9001 Certified Manufacturer
 - f. UL verified for EIA/TIA electrical performance
 - g. Comply with FCC Part 68
 - h. Cable termination: IDC type universal T568A or T568B.
 - 2. Mechanical Performance:
 - a. Plug Insertion Life: 750 insertions
 - b. Contact Force: 3.5 oz (99.2 g) minimum using FCC-Approved modular plug.
 - c. Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack.
 - d. Temperature Range: -40° to 150°F (-40 ° to 66 ° C)
- B. Design selection: modular SCS jacks shall be selected according to the following criteria:
 - 1. Performance requirement: CAT6
 - 2. Style: Rear loading
 - 3. Mounting orientation: straight mounting
 - 4. Color: To match faceplate
 - 5. Dust cover required: No
 - 6. Shielding: use shielded modular jacks only with ScTP cable.

- C. Approved manufacturer: Ortronics, Panduit, Siemon, CommScope, Belden, Leviton or Hubbell.

2.2 OTHER MODULAR JACKS

- A. Whenever indicated in the design drawings SCS outlets could have terminations for other media types like fiber optic cables, coaxial cables or audio cables. Whenever those type of media are indentified in the drawings, the following specifications shall be meet for modular jacks mounted in SCS outlets:
 - 1. Style, mounting orientation and color: match design selection for modular SCS jacks.
 - 2. Broadband distribution system connector: Use modular jack with F connector bulkhead rated at 75Ω.
 - 3. CCTV systems: use modular jack with BNC connector bulkhead rated at 75Ω
 - 4. For line level audio signals: use modular jack with RCA connector bulkhead. Use different color coded insulators for different audio channels.
- B. Approved manufacturer: Match selection for modular SCS jacks.

2.3 FACEPLATES

- A. Faceplates shall be used for all flush mounted telecommunication outlets to house modular jacks. Faceplates shall have the following specifications:
 - 1. Construction material: High impact thermo Plastic.
 - 2. Size: use single gang faceplates only unless specifically noted in the design drawings.
 - 3. Capacity of modular jacks per faceplate: faceplate shall be selected as to accommodate the amount of cables in each telecommunication outlet. No more than one unused opening shall be present on each faceplate.
 - 4. Color: submit color to A&E for approval.
 - 5. Labels: faceplate shall have two (2) recesses for labels, top and bottom, and shall have transparent label snap-on covers.
 - 6. Faceplate style: Direct modular plug rear loading style.
- B. All faceplates shall have a tamper resistant cover to access the modular jacks
- C. Approved manufacturer: Match selection for modular SCS jacks.

2.4 FACEPLATES WITH SUPPORT STUDS

- A. Telecommunication outlets indicated in the design drawings as to be wall mounted telephone outlets shall be composed of one modular SCS jack and one faceplate with support studs mounted on an electric box. Faceplates with support studs shall have the following specifications:

1. Construction material: Stainless Steel.
2. Size: use single gang faceplate with two support studs.
3. Capacity of modular jacks per faceplate: One.
4. Faceplate style: Direct modular plug rear loading style.

B. Approved manufacturer: Match selection for modular SCS jacks.

2.5 SURFACE MOUNTED BOXES

A. Telecommunication outlets indicated in the design drawings as to be surface mounted outlets shall be composed of modular jacks mounted in a surface mounted box inside an electrical enclosure. Surface mounted boxes shall have the following specifications:

1. Construction material: High impact thermo Plastic.
2. Capacity of modular jacks per surface mounted box: size of surface mounted box shall be selected as to accommodate the amount of cables in the surface mounted telecommunication outlet. No more than one unused opening shall be present on each box.
3. Color: White.
4. Labels: surface mounted boxes shall have at least one (1) recess for labels, and shall have transparent label snap-on covers

B. Approved manufacturer: Match selection for modular SCS jacks.

2.6 MOUNTING FRAMES

- A. All telecommunication outlets shall be properly mounted in the electrical raceway system provided for the outlet. The SCS installer shall select the proper mounting frame and/or bezel to mount the modular plugs in the raceway system. Raceway systems include furniture systems, floor boxes, poke-thrus, power poles, surface raceways system, etc.
- B. Whenever design drawings indicate a telecommunication outlet to be mounted in a furniture system the SCS Installer shall select the proper mounting frame to hold the modular jacks in the furniture system selected by the owner. Color of the mounting frames shall match the color of the furniture system.
- C. If owner provided furniture system does not have a raceway system for telecommunication, and design drawings indicate outlet to be mounted in the furniture system, SCS installer shall provide a plastic surface mounted box that allows the mounting of the modular plugs in a standard telecommunication faceplate.
- D. SCS installer shall provide all mounting frames and bezels to mount modular jacks inside floor boxes or poke-thrus.
- E. All un-used ports in mounting frames shall be covered with blank inserts.
- F. Approved manufacturer: Match selection for modular SCS jacks.

2.7 HORIZONTAL 4-PAIR CABLE

- A. General: Horizontal 4-pair cables shall be extended between the telecommunications outlet location and its associated equipment inside the TR. The cable shall consist of 4 pair cable solid copper conductors, certified to the specified performance standard. All horizontal 4-pair cables shall be terminated in modular jacks and patch panels with IDC type connectors and shall have the following specifications:
 - 1. Cable Gauge: minimum 23 AWG
 - 2. Performance standard: TIA/EIA CAT6
 - 3. Cable type: UTP
 - 4. Performance characterized to: 550 MHz
 - 5. Time delay skew: Maximum 45 ns/100m
 - 6. Input impedance (1-100MHz): 100Ω
 - 7. Cable diameter: ≤ 0.295 inch
- B. Cable jacket colors for 4-pair horizontal cables shall be selected according to the following criteria:
 - 1. Voice or data cables: Blue
 - 2. Wireless access points: Green
 - 3. Surveillance cameras: Red
- C. Performance verification: All performance of horizontal 4-pair cable shall be verified by a Nationally Recognized Testing Laboratory (NRTL) for EIA/TIA electrical performance and comply with FCC Part 68.
- D. Jacket: Cable jacket for inside premise cables shall comply with Article 800 NEC for correct use in the environment in which they will be used. If at the moment of the bid the SCS installer does not know the environment, in which cables will be used, the SCS installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant PVC jacket riser rated.
- E. OSP Jackets: All horizontal 4-pair cables run in conduits below the floor slab shall have a water resistant flooding compound and a jacket made of UV resistant polyethylene. Cables with PVC jackets are not acceptable for this application.
- F. Jacket marking: All horizontal 4-pair cables shall have at least two types of markings imprinted in the jacket, transmission performance marking and NEC rating for environment to be used.
- G. Approved manufacturer: Corning, Superior Essex, Belden, Panduit, Siemon, CommScope General Cable, or Berk-Tek.

2.8 PATCH PANELS FOR HORIZONTAL CABLING

- A. All 4-pair horizontal cables shall be terminated in rack mounted patch panel located in the telecommunication room's rack. These patch panels shall have the following specifications.

1. Connector type: 8-position modular plug (RJ-45)
2. Cable termination: IDC type universal T568A or T568B.
3. Performance requirement: CAT6
4. Maximum connectors per path panel allowed: 48
5. Patch panel type: factory preloaded panels
6. Patch panel shape: straight (flat)
7. Permanent marking: All connectors shall be labeled in sequential numbers
8. Field labels: patch panels shall have a space for field labels covered with transparent protectors.
9. Shielding: use shielded patch panels only with ScTP cable.

- B. Approved manufacturers. Match selection for modular SCS jacks

2.9 HORIZONTAL WIRE MANAGERS

- A. Horizontal wire managers shall be mounted in racks to route cables from patch panels to vertical wire managers and to equipment. Horizontal wire managers shall have the following specification:

1. Style: Finger duct style with hinged cover.
2. Sides: front of rack
3. Minimum height: two RU

- B. Approved manufacturers. Match selection for modular SCS jacks

2.10 FOUR (4) PAIR PATCH CORDS

- A. Four (4) pair patch cords are required at the work area side and at the patch panel side to complete the connectivity path to the equipment. All 4-pair patch cords shall be factory tested and shall have molded boots to the cable jacket. Field made patch cords are not acceptable. Four pair patch cords shall have the following specifications:

1. Connectors: 8-pin modular plugs at both ends
2. Conductors: 4-pair stranded conductors.
3. Wiring map: See section 3 of this specification
4. Performance requirement: To match horizontal 4-pair cable performance
5. Cable type: UTP

- B. Approved manufacturers. Match selection for modular SCS jacks

2.11 SINGLE STRAND FIBER OPTICS CONNECTORS

- A. All fiber optic cables (horizontal or backbone cables) shall be terminated on fiber optic connectors at both ends of the cable with either single strand fiber optic connectors or array connectors. Single strand fiber optic connector shall be compliant with industry standard ANSI/TIA-568-C.3 and the applicable TIA/EIA Fiber Optic Connector Intermateability Standard (FOCIS) document, TIA/EIA 604 series. Single strand fiber optic connectors shall have the following specification:

1. Physical contact type: use UPC type connector for all application with the exception of applications of Broadband TV distribution systems or DAS systems. For those applications use APC type connectors.
 2. Connector type: SC as indicated in the drawings
 3. Security level: non-keyed connector
 4. Pairing style: simplex
 5. Acceptable attachment type: epoxy-less type, epoxy type or fusion spliced pig tail with factory pre-polished connector
 6. Fiber type: SCS installer shall select the connector according to the fiber type where connector will be installed. As an example use OM1 connectors only in OM1 fiber optic cables.
 7. Ferrule construction: use ceramic ferrule connectors only, plastic ferrules are not acceptable.
 8. Polish type: factory pre-polish or field polish
- B. All single strand fiber optic connectors shall include boots to protect the fiber optic cable. The SCS installer shall select the boot according to the fiber optic type selected. As an example use 900µm boots in 900µm coated fiber, use 250µm boots on 250µm coated fiber and use 2mm boots on 2mm jacketed fiber. All boots shall be color coded to identify the type of fiber connector used. Boots shall be beige for OM1 fiber, black for OM2, aqua for OM3 and OM4 or green.
- C. Single strand multimode fiber optic connectors shall have the following performance requirements:
1. The maximum insertion loss shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171.
 2. Connector reflectance shall be less than or equal to -26 dB when installed in accordance with the manufacturer's recommended procedure.
 3. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.
 4. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90° angle, with a maximum 0.5dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.
- D. Single strand single mode fiber optic connectors shall have the following performance requirements:
1. Maximum insertion loss shall be 0.75 dB per each mated connector pair when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171.
 2. Connector reflectance shall be less than or equal to -40 dB (UPC) when installed in accordance with the manufacturer's recommended procedure.
 3. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.
 4. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90° angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

5. Connectors shall meet the following performance criteria:

Test	Procedure	Maximum Attenuation Change (dB)
Cable Retention	FOTP-6	0.2 dB
Durability	FOTP-21	0.2 dB
Impact	FOTP-2	0.2 dB
Thermal Shock	FOTP-3	0.2 dB
Humidity	FOTP-5	0.2 dB

- E. Approved manufacturers. Ortronics, Corning, Belden, Panduit, Siemon, Leviton, CommScope or 3M

2.12 INSIDE PREMISE FIBER OPTICS BACKBONE CABLES

- A. Whenever design drawings indicate fiber optics backbone cables to be run inside premises, the following specification shall be followed for those cables:
1. Strand Count: As indicated in design drawings
 2. Fiber type: As indicated in design drawings
 3. Fiber coating: 900µm coating color coded. 250µm coating is acceptable for loose buffer cables but they shall be protected with break-out kits with color coded 900µm buffers at both ends of the cable.
 4. Fiber protection: aramid yarn around all strands for cables under 24 strands, and aramid yarn and jacket around each subunit (6 or 12 strands) for cables above 24 strands.
 5. Interlock requirement: Interlock armor is not required
 6. Jacket type: Flame-retardant PVC jacket or materials with superior performance.
 7. Color jacket: jacket shall be orange for OM1 or OM2 fiber, aqua for OM3 or OM4 fiber and yellow for OS1 or OS2 fiber.
 8. Fiber termination: fibers shall be field terminated.
 9. Buffer type: tight buffer required.
 10. Center strength member material: dielectric material
- B. Jacket: Cable jackets for fiber optic cables shall comply with Article 770 NEC for correct use in the environment in which they will be used. If at the moment of the bid the SCS installer does not know the environment, in which cables will be used, the SCS installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant riser rated jacket. Rating shall be printed in the cable jacket.
- C. Approved manufacturers: Match selection for horizontal 4-pair cable

2.13 FIBER OPTIC DISTRIBUTION CENTERS

- A. All fiber optic cables shall be terminated in fiber optic distribution centers. Inside premises horizontal fiber optic cables shall be terminated in one side (telecommunication room side) in a fiber optics distribution center (FODC). Backbone fiber optic distribution centers shall be terminated at both ends in a FODC. FODC are

composed of an enclosure and snap on adapters. These are the specifications of the enclosures for the FODC:

1. Mounting: Use rack mounted FODC enclosures in all rooms where racks are available or any type of rack rails. Use wall mounted FODC enclosures only when racks are not available like in outdoor enclosures, or other spaces different than telecom rooms.
2. Size: SCS Installer shall size the FODC based on the amount of fiber strands to be terminated in the FODC.
3. Front locking doors are required.
4. Locking door shall be transparent doors and shall have labeling cards.
5. Whenever fiber splices are indicated in the design drawings next to an FODC, enclosures shall be selected by the SCS installer as to have spaces to hold splice trays. FODCs under these conditions shall be able to hold the amount of splice trays required for the fiber count indicated in the drawings.

B. These are the specifications of the snap on adapters for the FODC:

1. Style: plate style
2. Connector type: SC to match fiber types of fiber optic cables
3. Maximum fiber strands allowed per adapter: 24
4. Security level: non-keyed connector keyed connector
5. Pairing style: duplex

C. Approved manufacturers. Match selection for fiber optic connectors

2.14 FIBER OPTICS PATCH CORDS

A. Fiber optic patch cords shall be required for connections from active equipment to FODCs and/or to telecommunication outlets. Fiber optic patch cords shall be required at both ends of fiber optics backbone cables or horizontal fiber optic cables. Direct connection of backbone cables or horizontal fiber optic cables to active equipment shall not be allowed.

B. Fiber optic patch cords shall be all factory tested. Field made fiber optic patch cords are not acceptable. The specifications of the fiber optic patch cords shall be:

1. Strand Count: 2 strands
2. Fiber type: Match fiber type of backbone cable or horizontal cable.
3. Fiber connector in FODC or outlet side: match connector for each adapter
4. Fiber connector in active equipment side: the SCS installer shall coordinate with supplier of equipment the type of connector required in this side.
5. Fiber protection: aramid yarn
6. Jacket type: 2.9mm flame-retardant PVC jacket zip-cord type.
7. Color jacket: jacket shall be orange for OM1 or OM2 fiber, aqua for OM3 or OM4 fiber and yellow for OS1 or OS2 fiber.

C. Approved manufacturers. Match selection for fiber optic connectors

2.15 INSIDE PREMISE MULTIPAIR BACKBONE CABLES

- A. Whenever indicated in the drawings multipair backbone cables to be run inside premises and above grade shall have the following specification:
 - 1. Pair count: as indicated in the design drawings
 - 2. Conductor: AWG 24 solid bare copper conductor
 - 3. Input impedance: 100 Ω
 - 4. Conductor insulation: color coded thermo plastic
 - 5. Performance requirement: UL verified to ANSI/TIA-568-C Category 3 backbone cable.
- B. Jacket: Cable jacket for inside premise multipair backbone cables shall comply with Article 800 NEC for correct use in the environment in which they will be used. If at the moment of the bid the SCS installer does not know the environment, in which cables will be used, the SCS installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant PVC jacket riser rated.
- C. Jacket marking: All inside premise multipair backbone cables shall have at least two types of markings imprinted in the jacket, transmission performance marking and NEC rating for environment to be used.
- D. Approved manufacturer: Belden, Superior Essex, TE Connectivity, General Cable, Berk-Tek or CommScope.

2.16 TERMINATION OF MULTIPAIR BACKBONE CABLES

- A. Backbone multipair backbone cables for inside premises or outside plant shall be terminated in termination blocks or patch panels. See design drawings for specific types on each case.
- B. Whenever indicated in the design drawings, multipair backbone cables shall be terminated in patch panels. Patch panels for this purpose shall have the following specifications:
 - 1. Connector type: 8-position modular plug (RJ-45)
 - 2. Connector wiring map: One pair per connector pins 4 and 5 (blue pair).
 - 3. Cable termination type: IDC type connector
 - 4. Performance requirement: CAT3
 - 5. Maximum connectors per patch panel allowed: 96
 - 6. Permanent marking: All connectors shall be labeled in sequential numbers
 - 7. Field labels: patch panels shall have a space for field labels covered with transparent protectors.
 - 8. Shielding: Unshielded.
- C. Whenever indicated in the design drawings, multipair backbone cables shall be terminated in rack mounted termination blocks. Termination blocks for this purpose shall have the following specifications:

1. Connector type: 110 style connector
 2. Cable termination type: IDC type connector
 3. Performance requirement: CAT3
 4. Rack frame: standard 19" rack.
 5. Pair counts: use 100 pair blocks for backbone cables under 100 pairs. Use 200 pair blocks in quantities as required for backbone cables with over 200 pairs.
 6. Wire managers: All 200 pair termination blocks shall have a 2 RU wire manager built-in.
 7. Clip types: Use 110C4 clips or 110C5 clips.
 8. Field labels: termination blocks shall have a space for field labels covered with transparent protectors.
 9. Mounting: termination block shall be mounted without legs in the rack plate.
- D. Whenever indicated in the design drawings, multipair backbone cables shall be terminated in wall mounted termination blocks. Termination blocks for this purpose shall have the following specifications:
1. Connector type: 110 style connector
 2. Cable termination type: IDC type connector
 3. Performance requirement: CAT3
 4. Pair counts: Use only 300 pair blocks in quantities as required for backbone cables.
 5. Wire managers: All termination blocks shall have a wire manager installed at both sides of the blocks and between blocks.
 6. Clip types: Use 110C4 clips or 110C5 clips for 110 style block.
 7. Field labels: termination blocks shall have a space for field labels covered with transparent protectors.
 8. Mounting: termination block shall be mounted with legs on the wall.
- E. Approved manufacturers. Match selection for modular SCS jacks

2.17 PATCH CORDS FOR MULTIPAIR BACKBONE CABLES

- A. Patch cords shall be used to connect horizontal wiring to termination blocks for multipair backbone cables. Depending on the type of termination for backbone cables, the patch cord shall be selected.
- B. When multipair backbone cables are terminated in patch panels, patch cords for these patch panels shall have the same specification as the 4-pair patch cord cables described above.
- C. When multipair backbone cables are terminated in wall mounted or rack mounted termination blocks, patch cords shall have a patch plug connector in one end and an 8-pin modular plug (RJ-45) in the other end. The SCS installer shall coordinate with the phone system installer and determine if one pair or two pairs are required for each phone. Patch cords shall have one or two pairs according to the equipment selection. Patch plugs shall only be one or 2 pairs accordingly. Patch plug selection shall match the manufacturer and family of products of the termination blocks.

2.18 TWO POST RACKS

- A. Whenever indicated in the design drawings two post racks shall be provided as shown. Two post racks shall be made of aluminum or welded steel frames and shall have a powder coat finish. Two post racks shall have the following specifications:
1. Height: Equipment cabinet shall provide a usable height between 44 and 45 RU.
 2. Channel depth: 6" \pm 1"
 3. Rack rails type: standards EIA 19" located in the front and back of rack. Rack rails shall have RU marked and labeled.
 4. Rack screw type: #12-24 threaded rack rails. Screws shall be provided for all openings in rack rails and shall be made of steel.
 5. Weight capacity: UL listed for 1000 lb or more.
- B. Two post racks shall be provided with the following accessories:
1. Cable runway mounting brackets to support cable runway installed above racks
 2. Isolation pads
 3. Grounding kit.
 4. Ground bar: all cabinets shall be provided with a copper vertical ground bar covering the complete length of the rack rails. The ground bar shall be 1/8" thick and 1" wide with threaded holes 1032 mounted to the cabinet using nylon insulation washers
 5. End panels to support vertical wire managers at both ends of each rack row.
- C. Front vertical wire managers shall be provided in between all racks and at both ends of rack rows covering from top to bottom of each rack. The specifications of those wire managers shall be:
1. Style: Metal cage with dual hinged door cover.
 2. Sides: single sided wire manager or dual side wire manager.
 3. Capacity: Usable cross sectional area shall be minimum of: 48 sq-in.
 4. Accessories: whenever cable manager supports the use of spools inside the unit, spools shall be provided at all locations in the unit.
- D. Rear vertical wire managers shall be provided in between all racks and at both ends of rack rows covering from top to bottom of each rack. The specifications of those wire managers shall be:
1. Style: D-rings
 2. Sides: single sided wire manager (rear only) or if dual side wire front managers are included, no need for rear vertical wire managers.
 3. Capacity: Usable cross sectional area shall be minimum of: 16 sq-in.
 4. Accessories: whenever cable manager supports the use of spools inside the unit, spools shall be provided at all locations in the unit.
- E. Approved manufacturer: Panduit, Ortronics, Belden, Middle Atlantic Products, Great Lakes, Chatsworth Products Inc. or approved equal.

2.19 IDENTIFICATION AND LABELING TAGS

- A. SCS installer shall follow labeling materials indicated in specification section 270010.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES.

- A. GENERAL. All installation requirements indicated in specification section 270010 shall be followed.
- B. WORKMANSHIP. All work shall be completed by the SCS installer in a neat and workmanlike manner. The use of all BICSI standards and recommendations for installation shall be followed as the benchmark for workmanship.
- C. CABLE LENGTHS. It is the SCS installer's responsibility to plan the cable routing in the cable tray and other raceways as to minimize all cable runs to be able to stay under the 90 meter (295 ft) length limitation for Horizontal Cabling with the exception of UTP cables to outlets for Wireless Access Points for which the distance limitation is 80 meters (262 FT). All Horizontal cable shall be placed without diagonal runs. (i.e. parallel to walls and ceiling grid) unless otherwise specifically indicated on the drawings.
- D. WIRE MAPPING. All terminations of 4-pair horizontal cabling in this project and terminations of all 4-pair patch cords shall be per T568B standard.
- E. FIBER OPTICS TERMINATION POLARITY. All fiber optic cables (horizontal or backbone) terminated in duplex style adapter panels shall be connected in a cross-over polarity configuration. As an example, if fibers 1 and 2 are terminated in one end in positions A and B respectively in one side of the cable, the same strands shall be terminated in B and A positions in the other side of the cable.
- F. LOCATION OF HORIZONTAL TERMINATIONS. In a multi-story facility with telecommunications room in every floor, all horizontal drops, whether terminated in the wall or in floor boxes shall be terminated in the same floor telecommunications room as the location of the final outlet.
- G. CABLE BUNDLES. In suspended ceiling and raised floor areas if duct, cable trays or conduits are shown on the contract drawings, the SCS installer shall bundle, in bundles of 40 or less, horizontal wiring with cable ties snug, but not deforming the cable geometry. The cable bundling shall be supported via "CLIC" fasteners in TR's and non-plenum areas and J-hooks in ceiling spaces. The SCS installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all cables.
- H. CLIC FASTENERS: Horizontal cables shall be suspended by "CLIC" fasteners with cable inserts in TR's on the plywood area where ladder tray or rack management is not available per the design documents. Listings: "CLIC" fasteners shall be in accordance with NEC and BICSI standards. Above the plywood area J-hooks or D-rings should be used.

- I. **FIRE STOP PROTECTION:** Sealing of openings between floors, through rated fire and smoke walls, existing or created by the SCS installer for cable pass through shall be the responsibility of the SCS installer. Sealing material and application of this material shall be accomplished in such a manner, which is acceptable to the local fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the SCS Installer's work. Any openings created by or for the SCS installer and left unused shall also be sealed as part of this work. Penetration rating shall equal structure rating.
- J. **NEW MATERIALS:** All components, wiring and materials to be used for the installation of the SCS shall be new and free of defects. Used components, wiring and materials shall only be used when specifically indicated in the design drawings.
- K. **DAMAGE:** The SCS Installer shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces including painting and ceiling tile replacement shall be included as part of this contract.
- L. **AVODING EMI:** To avoid EMI, all pathways shall provide clearances of at least 4 feet (1.2 meters) from motors or transformers; 1 foot (0.3 meter) from conduit and cables used for electrical-power distribution; and 5 inches (12 centimeters) from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical-power cables and conduits. The SCS installer shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
- M. **WORK EXTERNAL TO THE BUILDING:** Any work external to the confines of this building as shown on the drawings shall be governed by the provisions of this specification.
- N. **DEMOLITION.** Any task part of the installation of the SCS requiring relocation, rerouting and/or demolition shall be done according to the following requirements:
 - 1. **Coordination:** Prior to any deactivation and relocation or demolition work, arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.
 - 2. **Provisions:** All deactivation, relocation, and temporary tie-ins shall be provided by the SCS installer. All demolition, removal and the legal disposal of demolished materials of system designated to be demolished shall be provided by the SCS installer.
 - 3. **All Existing Voice/Data cables and connecting hardware not to be used after the new installation is complete and within the areas where work is required as part of this project shall be removed by the SCS installer. All existing cables to be left for future use if indicated by the owner shall be tagged for that purpose.**
 - 4. **Owners Salvage:** The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.
 - 5. **Phasing:** The SCS installer shall perform all work in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

- O. **CONS.** Faceplates, jacks or patch panels with inserts for icons shall be filled with icons when unit capable of accepting icons. Icons in the work area side (outlet) shall match the color of the faceplate.
- P. **BLANK INSERTS AND PANELS.** All telecommunications outlets with faceplates or mounting frames with unused terminations shall be plugged with blank inserts or panels. Blank inserts shall match the color of the faceplate or mounting frame. No more than one blank module shall be required for each faceplate. All unused ports in the FODC enclosures for adapter panels shall be filled with blank adapter panels.
- Q. **PATCH PANEL AND FODC SEPARATION:** Horizontal cables shall be terminated in separate patch panels according to the use of the cable. Each series of patch panels or FODC for a specific use shall have at least 20% spare capacity of ports. Patch panels of the same use shall be mounted consecutive in the equipment cabinets or racks. The following separation for patch panels and FODCs shall be provided:
1. Cables for Wireless Access Points (WAPS) shall be separated from cables for any other purpose.
 2. Cables for surveillance cameras shall be separated from cables for any other purpose.
 3. Cables for voice drops shall be separated from cables for data drops.
 4. Cables for any other specialty systems like security systems, nurse call systems or others shall all be terminated in separate patch panels from any other cables.
 5. Horizontal fiber optic cables shall be terminated in separate FODC from fiber optics backbone cables.
 6. Single mode fiber optic backbone cables shall be terminated in separate FODC from multimode fiber optic backbone cables.
- R. **SUPPORTS FOR REAR OF PATCH PANELS.** All patch panels for horizontal cables shall be provided with a rear support bar to hold the cable and to provide strain relief. At a minimum one rear support bars shall be provided for each two rows of 24 connectors.
- S. **HORIZONTAL WIRE MANAGERS.** Horizontal wire managers shall be provided following this criteria:
1. At least one above and below each straight (flat) patch panel.
 2. At least one top and bottom of each series of angled or curved patch panels.
 3. At least one above and below any network switches.
 4. At least one below any rack mounted termination block.
- T. **CROSS OVER WIRE MANAGERS.** Cross over wire managers shall always be used with angled or curved patch panels. One cross over wire manager shall always be installed in the middle of each rack at the same height on every rack.
- U. **PATCH CORD QUANTITY, COLOR AND LENGTHS.** Copper and fiber optics patch cords shall be provided per following chart. All percentage calculations shall be rounded off to the nearest integer number.

TYPE	QTY	COLOR JACKET	LEGTH
4-pair at work area outlet	One for 90% of all 4-pair horizontal cables in the project	Match horizontal cable color jacket	30% 8', 50% 10' and 20% 14'
4-pair at WAP location	One for 100% of all 4-pair horizontal cables for WAPS in the project + 10% spare	Match horizontal cable color jacket	The SCS installer shall field verify all lengths to match location of WAPS selected by owner or wireless survey. For pricing purposes use 12'
4-pair at Surveillance camera	One for 100% of all 4-pair horizontal cables for cameras in the project +10%	Match horizontal cable color jacket	The SCS installer shall field verify all lengths to match location of cameras. For pricing purposes use 12'
4-pair at patch panel side (excluding surveillance cameras and WAPS)	One for 90% of all 4-pair horizontal cables in the project	Match horizontal cable color jacket	For pricing purposes use: 40% 6', 40% 8', 20% 12'. SCS installer shall field verify these percentages to provide more accuracy.
4-pair at patch panel side (surveillance cameras and WAPS)	One for 100% of all 4-pair horizontal cables in the project +10%	Match horizontal cable color jacket	For pricing purposes use: 40% 6', 40% 8', 20% 12'. SCS installer shall field verify these percentages to provide more accuracy.
2-strand fiber optics at work area outlet	One for 100% of all 2-strand horizontal fiber cables in the project + 10% spare	Per fiber type	50% 8' and 50% 10'
2-strand fiber optics at FODC.	One for 100% of all horizontal 2-strand fiber cables and one for 83% of all fiber strands of backbone cables in the project. For example a 24 strand cable shall require 20-2-strand patch cords or 10 for each side of the cable	Per fiber type	For pricing purposes use: 20% 6', 60% 10'. 20% 14' SCS installer shall field verify these percentages to provide more accuracy.
One or two pair for copper backbone cross connects	One for 90% of all backbone copper pairs installed in the project.	Gray	For pricing purposes use: 80% 8', 20% 10'. SCS installer shall field verify these percentages to provide more accuracy.

- V. **CABLE SLACK.** Cable slack shall be provided for all cables in the project following this guideline:
1. At each work area outlets, all horizontal cables shall have 12" of slack.
 2. At the telecom room side all horizontal cables shall have at least 6' neatly organized on the wall using a figure 8 configuration or a non-loop shaped arrangement with Velcro straps.
 3. Backbone cables at termination points shall have at least 15' of slack neatly organized on the wall using a standard loop and Velcro straps.
 4. Outside plant backbone cables run through in-ground pull boxes greater than 24"X24" shall include one service loop inside the box.
- W. **BEND RADIUS.** Installation of Fiber Optic Cables shall be in accordance with ANSI/TIA-568C guidelines and cable manufacturer specifications. Bend radius parameters shall be followed for load and no load conditions. Cable installation and terminations that do not comply shall be replaced by the SCS installer. If no recommendation is specified by cable manufacturer, at least the following criteria shall be met:
1. The bend radius for intrabuilding 2 and 4-fiber horizontal optical fiber cable shall not be less than 25 mm (1 in) under no-load conditions. When under a maximum tensile load of 222 N (50lbf), the bend radius shall not be less than 50 mm (2 in).
 2. The bend radius for intrabuilding optical fiber backbone with fiber counts above 4 shall not be less than 10 times the cable outside diameter under no-load conditions and no less than 15 times the cable outside diameter when the cable is under tensile load.
 3. The bend radius for interbuilding optical fiber backbone shall not be less than 10 times the cable outside diameter under no-load conditions and no less than 20 times the cable outside diameter when the cable is under tensile load up to the rating of the cable, usually 2670 N (600lbf).
- X. **INNERDUCT.** Innerduct shall be provided from end to end of a raceway system under the following conditions:
1. Inside underground conduits as indicated in design drawings.
 2. For horizontal fiber optic cable or inside premise fiber optics backbone cables without interlocking armor when routed through cable trays, ladder trays or vertical conduit sleeves. This requirement is usually not indicated in the drawings but indicated only in this specification.
 3. For backbone fiber optic cable in vertical risers
- Y. **SCS PROTECTION DURING CONSTRUCTION.** The SCS installer shall protect all SCS materials from damage during construction. Racks shall be covered with fabric or plastic after mounting to prevent dust, debris and other foreign materials having contact with SCS devices. The SCS installer shall protect at all times all fiber optic and copper cables from damage during installation. All cables shall maintain the physical integrity as manufactured for testing and delivery to the owner. All damaged cables shall be replaced at no additional cost to the owner.

- Z. CABLE BONDING. Shielded cables or cables with metal strength or protection members (like interlocking armor) shall be bonded to the telecommunications grounding system as indicated in specification section 270526.
- AA. RACK INSTALATION. All racks shall be installed leveled and plumbed. Four post racks and two post racks shall be anchored to the floor and shall be installed with isolation pads. Equipment cabinets shall be leveled using the leveling feet unless design drawings specifically indicate to leave them on the casters.
- BB. RACK BONDING. All equipment cabinets and racks shall be bonded to the telecommunication grounding system as indicated in specification section 270526

3.2 IDENTIFICATION AND TAGGING

- A. General: Identification and tagging of SCS components shall be executed by the SCS installer. At a minimum identification and tagging shall be provided for the following components of the system:
 - 1. All horizontal and backbone cables at both ends of the cable in the cable jacket. Labels on each side shall be different indicating the location of the other side of the cable
 - 2. All faceplates indicating all jacks terminated in the faceplate.
 - 3. All patch panels.
 - 4. All racks
 - 5. All termination blocks
 - 6. All telecommunication rooms and outdoor enclosures.
 - 7. All interbuilding backbone cables inside in ground pull boxes outside of the building shall have a visible label in each box they pass through.
- B. The SCS installer shall follow the owner provided identification system. If owner does not have any preference or standard the SCS installer shall provide a system for approval of the A&E and the owner as indicated in the submittal paragraph of this specification. The identification system shall follow the TIA/EIA 606-B standard.

3.3 TESTING OF COPPER CABLING

- A. General: Horizontal and backbone cabling shall be verified in accordance with ANSI/TIA/EIA-568-C, Cabling Transmission Performance and Test Requirements.
- B. The test method selected for all 4-pair copper cabling is a permanent link style test. Channel style test is defined as a test that included the patch cords to be used in the project. Each channel test shall include one patch cord and one work-area cord, with no cord used twice. Permanent link test is defined as a test that does not include the patch cords to be used in the project.
- C. General: In the event the A&E elects to be present during the tests, provide notification to the engineer two weeks prior to testing.

- D. General: The installer's RCDD shall sign off on all copper and fiber optic cable test results, indicating that he/she was in responsible charge of all cable testing procedures and that all cables were tested in compliance with the contract documents and met or exceeded the requirements stated herein.
- E. Testing Equipment: Tester shall be as manufactured by Agilent, Fluke, IDEAL or Wavetek. Tester shall be 100% Level III compliant with ANSI/EIA/TIA 568C specifications for testing of the CAT6 cabling. No tester will be approved without meeting these requirements.
- F. Each jack in each outlet shall be tested at a minimum to the manufacturer's performance of the cable to verify the integrity of all conductors and the correctness of the termination sequence. Testing shall be performed between work-areas and the equipment rack patch panel. Prior to testing UTP runs, the tester shall be calibrated per manufacturer guidelines. The correct cable NVP shall be entered into tester to assure proper length and attenuation readings.
- G. Documentation of cable testing shall be required. The SCS installer shall provide the results of all cable tests in electronic format (final results in PDF format and raw data). Each test page shall be separated by standard page break (one test per page). The test results shall include: sweep tests, continuity, polarity checks, wire map, Attenuation, NEXT, PSNEXT, FEXT, PSFEXT, ELFEXT, PSELFEXT, ACR, Return Loss, Delay Skew, and the installed length. Cables not complying with the EIA/TIA 568C tests results shall be identified to the A&E for corrective action which may include replacement at no additional expense to the Owner. All identification names of the cables used in the test shall match the labeling system approved for the project and the corresponding shop drawings.
- H. Any Fail, Fail*, Pass* or WARNING test result yields a Fail for the channel or permanent link under test. In order to achieve an overall Pass condition, the result for each individual test parameter must be passed. All test results shall come from a tester with the permanently enabled marginal reporting feature.
- I. Test results shall show and comply with the margin claimed by the manufacturers over CAT6 permanent link specifications on all transmission parameters across the entire frequency range as shown on the manufacturer's cut sheets.
- J. General: Copper multipair backbone cabling shall be tested for length, continuity, polarity checks and wire map. The SCS Installer shall provide the results of all Copper Riser cable tests in electronic format. The use of pigtailed or special harness could be required to properly test these cables.
- K. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests.
- L. All 4-pair patch cords shall be factory tested only.

3.4 TESTING OF FIBER OPTICS CABLING

- A. General: Horizontal and backbone cabling shall be verified in accordance with ANSI/TIA/EIA-568-C and the addendum for fiber optic testing.
- B. General: In the event the Engineer elects to be present during the tests, provide notification to the engineer two (2) weeks prior to testing.
- C. Cleanness: All fiber optics connector shall be cleaned properly before any testing and after testing. Proof of cleanness shall be required during the acceptance test for the SCS by the A&E. SCS installer shall have available during this test a 200X microscope or a video probe to demonstrate the cleanness of the randomly selected connectors by the A&E.
- D. End to End Attenuation Test: The SCS installer shall perform end-to-end attenuation testing for each multimode fiber at 850 nm and 1300 nm from both directions for each terminated fiber span in accordance with EIA/TIA-526-14A (OFSTP 14) and single-mode fibers at 1310 nm and 1550 nm from both directions for each terminated fiber span in accordance with TIA/EIA-526-7 (OFSTP 7). A one jumper reference shall be used for all testing. For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be < 2.0 dB. When calculating the link loss budget for spans greater than 90 meters use the values listed below. End to end attenuation shall be done with a Level II meter using a meter and light source equipment (also known as main and remote unit)

ATTENUATION DUE TO	FIBER TYPE	MAX. ATTENUATION
Terminating connectors. Field terminated options	All fiber types	0.75 dB per connector
Terminating connectors, pre-term fibers	All fiber types	No more than 0.2 dB additional to total dB loss measured at the factory in report sent by cable manufacturer.
Splices	All fiber types	0.3 dB per splice
Distance	OM1 (850nm/1300)	3.4 dB /1.0 dB per Km.
Distance	OM2, OM3 and OM4 (850nm/1300)	3.0 dB /1.0 dB per Km.
Distance	OS1 and OS2 (1310 nm/1383 nm/1550 nm)	0.65 dB /0.65 dB/ 0.5 dB per Km.

- E. OTDR Test. Additional to end to end attenuation test, all fiber optic cables shall be tested with a Level III OTDR equipment for the following conditions:
 - 1. Each known event (connector/splice) insertion loss at both windows for each fiber type (850/1300 nm for multimode and 1310/1550 nm for single mode). All events shall pass maximum allowed insertion loss for the event type as indicated in table above.
 - 2. Overall insertion loss of the cable at both windows. Adding all events and cable length.
 - 3. Estimated distance.

4. Cable signature in the form of traces along the complete distance of the cable. Unexplained cable reflections shown in the OTDR shall require the installer to submit letter explaining such events and pictures of cable conditions in the locations where the unexplained events are located to demonstrate cable has not been kinked or damaged during installation.
- F. OTDR Test conditions. All OTDR testing shall be performed with the following conditions:
1. Use a launch cable and a tail cable in accordance with fiber type being tested and requirements indicated by OTDR equipment manufacturer.
 2. Launch and tail cables shall be products sold by testing equipment manufacturer and not field made cables.
 3. Launch and tail cables shall be selected according to the type of connector being tested such as APC or UPC type connectors.
 4. Use launch compensation mode during the test to subtract the effects of the launch and tail cables.
 5. Test from one direction only, unless the presence of "gainers" are spotted during the test. In such case the installer shall test in both directions and adjust the test equipment to average measurements from both directions.
 6. The SCS installer shall verify the backscatter coefficient use in the test to make sure it matches the coefficient of the cable being tested.
- G. OTDR Testing Equipment used on this project shall have the specifications indicated in this following table:

SPECIFICATION	MULTIMODE	SINGLE MODE
Wavelengths	850 nm \pm 10 nm 1300 nm \pm 35 / -15 nm.	1310 nm \pm 25 nm. 1550 nm \pm 30 nm.
Event Dead Zone. Measured at 1.5 dB below non-saturating reflection peak with the shortest pulse width. Reflection peak < -40 dB for mm and < -50 dB for sm.	850 nm: 0.5m typical 1300 nm: 0.7m typical	1310 nm: 0.6m typical 1550 nm: 0.6m typical
Attenuation Dead Zone. Measured at \pm 0.5 dB deviation from backscatter with the shortest pulse width. Reflection peak < -40 dB for mm. and < -50 dB for sm.	850 nm: 2.2m typical 1300 nm: 4.5m typical	1310 nm: 3.6m typical 1550 nm: 3.7m typical
Pulse Widths (nominal)	850 nm: 3, 5, 20, 40, 200 ns. 1300 nm: 3, 5, 20, 40, 200, 1000 ns.	3, 10, 30, 100, 300, 1000, 3000, 10000, 20000 ns
Loss Threshold Setting	0.01 dB to 1.5 dB Adjustable in 0.01 dB increments	0.01 dB to 1.5 dB Adjustable in 0.01 dB increments

- H. The Test Report for each fiber strand shall include the following information:
1. Calculated Loss Budget for each optical fiber link (see attenuation table above)
 2. Cable/strand ID matching shop drawings labeling system.
 3. Name of technicians who performed the test.
 4. Date and time the test was performed.
 5. Measurement direction (from/to)
 6. Jumper reference set up date/time and attenuation value
 7. Equipment model and serial number used and calibration date.
 8. End to End Attenuation Loss Data for each optical fiber link
 9. OTDR Traces, one page per strand. Expand chart to cover most of the page
 10. Each event loss data and test limits used, including test limit file date used.
- I. For fiber optic cables with factory terminated connectors or pre-terminated pig-tails, The SCS installer shall provide also the test results performed at the factory for fiber optic cables with factory terminated connectors to compare with the field test done by the SCS installer. No significant variation between the factory test results and the field test results shall be encountered.

3.5 SYSTEMS WARRANTY AND SERVICE

- A. SCS Installer shall follow all warranty and service requirements indicated in specification section 270010.
- B. Warranty: The SCS shall be required to be under the manufacturer's warranty program for a complete channel configuration including cable, jacks, patch cords and patch panels and include cabling specifically approved for the channel configuration with the manufacturer's components. Manufacturer shall provide the warranty worst-case performance data for the installed cabling system, and the performance data indicated in the warranty documents/certificate.
- C. A twenty five (25) year warranty available for the Structured Cabling System (Fiber optics and copper infrastructure) shall be provided for an end-to-end channel model installation which covers applications assurance, cable, connecting hardware and the labor cost for the repair or replacement thereof.
- D. Additional features of the warranty shall include:
1. That the SCS installed system complies with the margin claimed by the manufacturer above the category 6 channel specifications on all transmission parameters across the entire frequency range of 1-600 MHz as shown on the manufacturers catalogs and literature.

3.6 ENGINEER'S FINAL ACCEPTANCE TEST

- A. SCS Installer shall follow all requirements for final acceptance indicated in specification section 270010.

- B. The Engineer's final acceptance test will not include testing of structured cabling components, but could include verification of cleanness of fiber optic connectors.

3.7 TRAINING AND INSTRUCTION

- A. Training shall only be done after all testing and identification process has been completed and passed as indicated in this specification. Any training done prior to final acceptance will not be accounted for the formal training requested and the SCS installer shall re-do all training after the final acceptance test is passed, at no additional cost to the Owner.
- B. SCS Installer shall follow all training requirements indicated in specification section 270010
- C. The training for the SCS shall include the following topics:
 - 1. Detail explanation of the identification system.
 - 2. A walkthrough of all spaces and locations where terminations have been done in the project.

3.8 AS BUILT DOCUMENTS AND PROJECT CLOSE OUT

- A. The SCS shall follow all requirements for as-build and close out documents indicated in specification section 270010
- B. The following are additional requirements supplementing the information provided in specification section 270010:
 - 1. Provide the Warranty certificate issued by the manufacturer of the SCS infrastructure.
 - 2. The installer's RCDD shall affix his/her stamp to the as-built drawings, indicating that he/she has reviewed and approved the drawings as being complete, accurate, and representative of the system as actually installed.
 - 3. As built drawings inside each telecom room. The SCS installer shall plot all as-built drawings and locate them inside each of the telecom rooms in the project. Each telecom room shall have the as-built drawings of the areas being served from that room. Each drawing shall be placed inside a clear vinyl document protector the size of the actual design drawing and affixed to a wall/plywood in the telecom room. The document protector shall be re-usable and shall allow the owner to replace the drawings as changes are done to the SCS infrastructure in the future. Without this information, substantial use of the system will not be provided to the installer.
 - 4. The SCS installer shall provide Excel software spreadsheet that defines the telecommunications outlet number, location, number of voice, data and special jacks. This database shall also provide the outlet patch panel connection to the riser/inter-floor cable, equipment, and telephone company demarcation circuit pairs as part of the as-built documentation.

5. Electronic copies of all test results (copper and fiber). Electronic copies shall include raw data files and PDF files with results. PDF files shall be organized the following way:
 - a. All copper cables for cables terminating in one telecom room in a single PDF files with the name equal to the label used in the shop drawings for the telecom room where the cables are terminated.
 - b. All attenuation and OTDR test for all strands of a single cable shall be in one PDF file with the name corresponding to the Cable ID used in the shop drawings.

END OF SECTION 271000

SECTION 274100

AUDIO/VISUAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General: The General Requirements, Conditions of the Contract, these Specifications, Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc...) shall apply to the work of this specification section.
- B. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.
 - 1. 270010 Technology General Provisions
 - 2. 270528 Raceways for Technology
 - 3. 271000 Structured Cabling System
 - 4. 270526 Grounding and Bonding for Communication Systems

1.2 SCOPE OF WORK (SOW)

- A. General: Refer to the requirements of the related documents identified in Part 1.1 of this specification, for scope of work requirements, which are supplemented by this section. This shall constitute the basis for the "Scope of Work" for this specification.
- B. System: The goal of the project is to provide a finished, complete audiovisual system with the functionality, capacity, and operability, as described in the Contract Drawings and specifications herein. The finished, complete system shall serve as a vehicle for the transport of associated system signals from designated origination points to equipment interfaces and/or identified distribution points per the Contract Documents. The scope of work for the AVS installer shall include, but not limited to the following tasks:
 - 1. Preparation of shop drawings, submittals, training and as-built information for the system.
 - 2. Procurement, installation and warranty of all AVS hardware including projectors, flat panel displays, mounts for displays, signal transceivers, players, switchers, servers, etc.
 - 3. Procurement, installation and warranty of all AVS cabling and wiring, including support system, and fire stopping for all low voltage cabling part of the AVS.
 - 4. Programming labor of the AVS, including initial software set up, software registration, and initial data input, unless otherwise noted in this specification section.

5. Attend project plan meetings with the Owner and the Consulting Engineer (A&E) to fine tune data interchange details, network configuration and other user requirements:
 6. Provide training and close out information as indicated in this specification.
- C. It shall be understood by the AVS installers that this is an integrated system where multiple pieces of equipment from different manufacturers are required to be connected/interfaced together to make the AVS operational. To allow for competitive bidding multiple manufacturers are listed in the specifications for many devices and software, but it is the sole responsibility of the AVS installers to verify that their particular equipment and software selection integrate and work seamlessly with other equipment and software from the pool of approved manufacturers. These specifications represent a design guideline and design intent but they are not intended to verify that all possible equipment and software listed in this specification work and integrate seamlessly with any equipment and software from the pool of acceptable manufacturers. Approval of submittals for the AVS by the A&E of the project does not relieve the responsibility for the AVS installers to deliver a working system. Any equipment changes required because of incompatibility between different devices of a particular system, even after the equipment has been approved by the A&E, shall be provided at no additional cost to the owner.
- D. The following is a list of rooms where Audio Visual system shall be provided:
1. Courtroom 119, reference in the document as the "Courtroom AV system"

1.3 INSTALLER QUALIFICATIONS

- A. General: The qualifications and requirements herein apply to the specific technology identified by this specification section. Refer to the specification sections identified in Part 1.1 "Related Documents", of this specification, for additional requirements, which are supplemented by this section.
- B. All existing system in this Courthouse have been installed by:
- C.
1. Whitlock
 2. 5607 North Hiatus Road, Suite 300
 3. Tamarac, FL 33321
 4. Phone: 954-384-4286
 5. Fax: 954-473-0205
 6. Reid Holden – holdenr@whitlock.com
- D. Installer Qualifications: The Installer directly responsible for the work described in this specification section is also referenced as the AVS Installer. The Installer shall be a licensed and registered contractor who is, and who has been, regularly engaged in providing the installation of audiovisual systems of similar size and complexity for at least the immediate past five (5)-years.
- E. Project manager requirements: The project manager for each company participating in the installation of the AVS shall be a Certified Technology Specialist (CTS) by

Infocomm International. Proof of current certification shall be provided with the submittal

- F. Programmer-Installer: The AVS Installer must have a factory-trained programmer/installer, for the provided Project products, in full-time employment, as part of their staff. The AVS installer needs to provide certificates of completion of training for the staff that will be taking part in the execution of this project
- G. Qualification Documentation: The Installer shall provide the following documentation with their bid package, as evidence that the requirements for the Installer qualifications have been satisfied:
 - H.
 - 1. A list of not less than five (5) references for jobs of similar size and complexity including:
 - 2.
 - a. Project Names
 - b. Locations
 - c. Contact Names
 - d. Contact Telephone Numbers
 - e.
 - 3. Location (specific street address) of the office from which this installation and warranty work will be performed. It is preferred that the Installer has established and maintains a permanent office within 150 miles of the project site.
 - 4. Copies of Manufacturer certification certificates. It is required that the Installer possess the following certifications, at a minimum:
 - 5.
 - a. Biamp certified dealer, installer and programmer.
 - b. Crestron, DMC-E
 - c.
 - 6. Copies of Licensure certificates.
 - 7. Copies of Insurance and Bonding certificates.

1.4 MATERIALS ALTERNATES AND SUBSTITUTIONS

- A. General: See details for alternates and substitution in specification section 270010.
- B. Specific equipment: When the design drawings indicate a brand and a model number for a piece of equipment as part of the audio visual system, the AVS Installer needs to provide the same device as indicated. Substitutions for this type of equipment are not acceptable.
- C. Non-specific equipment: When the design drawings do not indicate a brand and a model number for a piece of equipment as part of the audio visual system, the AVS installer is free to pick equipment that meets the minimum specifications indicated in this section. The AVS installer needs to submit the selected choice as part of the submittal process

1.5 SHOP DRAWINGS AND SUBMITTALS

- A. The AVS installer shall follow all requirements for shop drawings indicated in specification section 270010.
- B. Project Start Submittals: A maximum of 60 days after the AVS installer receives a notice to proceed with the project, but no sooner than a year before substantial completion, the following information shall be submitted.
- C.
 - 1. Cut sheets with all specifications of every device, cables and connectors to be used in the project.
 - 2. One-line diagrams with all devices included in the systems. Each system in a different sheet.
 - 3. User interface and faceplate color submittal. The AVS installer shall prepare a separate submittal with the shape and color of all user interface plates to be approved by the Architect of the project or the Owner.
 - 4. Rack elevations of all AV equipment for all rooms in the project.
 - 5. Conduit rough-in requirements of all wall and ceiling mounted devices for all equipment part of the AVS system.
 - 6. Any installation and rigging details for loudspeaker systems or other heavy equipment part of the AV system.
- D. Construction Submittals: During the construction process the AVS installer shall submit various documents for approval prior to continuing with the installation process. Here is some of the information the AVS installer needs to submit:
- E.
 - 1. Before starting the programming process the AVS Installer shall provide the following information:
 - 2.
 - a. A schematic presentation of the layout of all the user interfaces in the project. The AVS Installer needs to get approval of this submittal before starting any programming.
 - b. Completely fill out network configuration template provided by TLC Engineering upon request, to explain all network devices to be used in a project and to get IP addresses from the network administrator.
 - c. A layout/presentation of any digital audio programming and user interfaces that are part of the project.
 - d. AVB map assignment. A list of all AVB channels from all rooms and all the routing shall be provided.
 - e. Detailed layout of the DSP filters to be used in each DSP processor.
 - f.
 - 3. Any design changes whether originated by the Owner, Designer or by the AVS Installer as a VE suggestion need to follow the same submittal process described in the previous paragraph for all equipment involved on the change.

1.6 PROJECT SPECIFIC SOURCE CODE OWNERSHIP

- A. Definition of project specific source code: Project specific source code includes all source code created to generate an executable file to be intended to run in any equipment used in the installation of the AVS. Examples of project specific source code include source code used to generate executable files for control processors, DSP processors and touch panels. Project specific source code does not include source code used to create programming tools and compilers or source code used to generate operating systems or application programs running in PC based workstations.
- B. Ownership: Any project specific source code used in this project shall remain the exclusive property of the Owner. By accepting the contract to perform the work included in this project, the AVS installer or designer and any other companies working creating project specific code during this project relinquish the right of ownership of this source code, and waive any licensing fees or royalties for the use of source code by the Owner or any company authorized by the owner to perform changes in the source code after the project is substantially completed for an undefined period of time.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONS

- A. System Signals for All Systems
- B.
 - 1. General: The completed system shall be capable of receiving, processing, routing and distributing the associated signals, noted herein, from and to the respective devices identified under Part 2 of this specification and the Contract Documents.
 - 2. The system shall provide an audio signal response of $\pm 6\text{dB}$ un-equalized ($\pm 3\text{dB}$ equalized) from 65Hz to 18KHz, throughout.
 - 3. Analog video signals through the system shall be maintained to the minimum quality requirements as follows:
 - 4.
 - a. The system shall provide a signal response of 0.7Vpp (nominal) @ 300Mhz RGB, throughout the system channel, for all visual content.
 - b.
 - 5. Digital video signals through the system shall be capable of delivering 1920X1080 resolutions at 24 fps from end to end.
 - 6. Control signals through the system shall be maintained to the minimum level established by the control equipment manufacturer for the control protocol utilized. This level shall be correct at all connection points in the system.

2.2 COURTROOM AV SYSTEM

- A. General: The AVS Installer shall provide a complete and operable system with the minimum functional requirements noted herein.

- B. Two separate control systems. This room has 2 separate and independent control systems. One system is for audio control and is based on the Biamp control platform. The user interface for this system is a Touch panel. The second control system is based on Crestron control and it is for the purpose of controlling video routing and video displays. The user interface for this system is a Control Processor & Touchscreen.
- C. Input sources: The AVS described for this room shall have multiple audio and video sources. Audio and video sources can be provided by a device part of the AVS or by owner provided equipment through an interface plate. The AVS Installer shall provide all source equipment except when noted in the design documents as provided by Owner or under a different division. Refer to design drawings to determine what and how many signal types will be used for each source. The AVS for this room shall have the following audio and video input sources:
 - D.
 - E. FOR AUDIO CONTROL SYSTEM
 - F.
 - 1. Wall plates with connectors and quantities as indicated in the design drawings.
 - 2. Microphones as shown in design drawings.
 - 3.
 - 4. FOR VIDEO CONTROL SYSTEM
 - 5.
 - 1. Wall plates with connectors and quantities as indicated in the design drawings.
 - G. Output devices: The AVS described for this room shall have multiple audio and video output devices. Audio and video output devices can be provided by a device part of the AVS or by owner provided equipment through an interface plate. The AVS Installer shall provide all output devices except when noted in the design documents as provided by Owner or under a separate division. Refer to design drawings to determine what and how many signal types will be used for each output device. The AVS for this room shall have the following audio video output devices:
 - H.
 - I. FOR AUDIO CONTROL SYSTEM
 - J.
 - 1. Wall plates with connectors and quantities as indicated in the design drawings.
 - 2. Sound reinforcement speakers as indicated in the design drawings
 - 3. Audio recording computer.
 - 4. Infrared Assisted Listening System
 - 5.
 - 6. FOR VIDEO CONTROL SYSTEM
 - 7.
 - 1. One (1) Projector type 1
 - K. Controllable devices: The AVS described for this room shall have a microprocessor based controller as indicated in the design drawings. This controller shall be capable of

managing all input sources, output devices and other devices part of the AVS. Refer to design drawings to determine what and how many signal types will be used for each controllable device. The following is a list of other controllable devices to be provided by this room.

L.

M. FOR AUDIO CONTROL SYSTEM

N.

1. One (1) Recording light (Owner provided contractor installed).
2. Two (2) DSP audio processor.
- 3.

4. FOR VIDEO CONTROL SYSTEM

5.

1. One Video switcher
2. One Projection screen

O. User Interfaces: The Owner shall be able to operate and receive system status information from the AV system through the following user interfaces:

P.

Q. FOR AUDIO CONTROL SYSTEM

R.

1. A desk mounted touch panel/Microsoft Surface device
- 2.
3. FOR VIDEO CONTROL SYSTEM

S.

1. A desk mounted Control Processor & touchscreen

T. User control: The Owner shall be able to use the above mentioned user interfaces to operate the AV system. All user interfaces shall be able to perform all tasks unless otherwise noted in the design drawings or this specification. The Owner shall be able to perform the following tasks and get the following status indication from the user interfaces:

U.

V. FOR AUDIO CONTROL

W.

1. Currently the owner has existing files used in the Biamp control system with the basic functionality of the courtroom audio. Changes will have to be done to the file to add the new functionality not described in the existing file. Among the features not currently established in the existing file:
2.
 - a. Select program audio to be sent to speakers/recorders as a new source.

- b. Additional outputs with volume control for the desktop speakers to be added in different location.
- c. Microphone mute controls for the microphone zones indicated in the design drawings. Single button touch mute.

X.

Y. FOR VIDEO CONTROL

Z.

- 1. Turn system on/off
- 2. Route video from any source to the destination (audio output to follow video input change)
- 3. Screen controls (up/down)
- 4. Vide mute.

2.3 WIRE, CABLE, CONNECTORS, AND ACCESSORIES

- A. General: The AVS Installer shall provide the system components and materials necessary to properly install, support, and terminate all audiovisual cabling, in accordance with the related documents identified in Part 1.1 of this specification. Where the Project Electrical Installer has provided a raceway designated for use by this system, the AVS Installer shall coordinate and install all required cables into the provided raceway. The AVS Installer shall also provide and attach all required cable connectors.
- B. Cable: The AVS Installer shall provide all cabling associated with, and required to, provide a complete, operable system in accordance with the Contract Documents. All cable provided by the AVS Installer shall be of a manufacture and quality consistent with the design intent, and shall be reviewed by the Engineer prior to installation.
- C. Cabling in air handling spaces. The AVS Installer is responsible for determining the rating of the cables to be used for the AVS, as per current version of the National Electrical Code. If, at the bidding point the AVS Installer is not certain about the type of cables to be used in the project, the AVS Installer shall assume that all cables need to be plenum rated cables.
- D. Cabling below grade: When cable part of the AVS have to be run in conduits below slab and grade level, the AVS Installer shall use only cables with water-blocking jackets.
- E. Cable signals: The following is a list of signal types and the cables to be used for those signals:
- F.
 - 1. Line level audio signal cable: Provide one (1) twisted pair cable for mono signals and two (2) twisted pair cables for stereo signals. Twisted pair cables to be 22 AWG stranded (7X30) tinned copper conductors with overall foil shield (100% coverage), with 22 AWG stranded tinned copper drain wire.

2. Microphone level audio signal cable: Provide one (1) twisted pair cable, 20 AWG stranded (7X28) tinned copper conductors, overall foil shield (100% coverage) with a 20 AWG stranded tinned copper drain wire.
3. Control cable (i.e. RS-232, RS-485 Signal): Provide one (1) cable with 1 or 2 twisted pair 22 AWG stranded bare copper conductors with overall aluminum/polyester foil (100% coverage) and a 24 AWG tinned copper drain wire. Pair count depends on manufacturer's specifications.
4. Digital video, audio and control over twisted pair. Provide one, two or more cables UTP or STP as required by transceiver equipment manufacturer to ensure the digital signal is transported properly up to 328 ft, at maximum resolution indicated in part 2.01 of this specification. If equipment manufacturer supports the use of standard UTP Category (5e, 6 or 6A) for this application, the AVS installers shall provide cables in compliance with specification section 271000 and all cables part of the AVS shall be included in the same warranty as all cables provided under specification section 271000. If equipment manufacturer requires the use of proprietary cables, only these cables shall be used in the project.
5. UTP Category cables. Provide UTP category cables for all Ethernet connection part of the AVS as indicated in design drawings, including horizontal cables, patch cords and station cables. All cables part of the AVS shall have all specifications and shall be included in the same warranty as all cables provided under specification section 27100
6. Speaker Cable: Provide two (2) unshielded bare high conductivity ETP copper 16 AWG stranded conductors, with overall jacket.
7. IR control signal cable. Provide one (1) pair, unshielded twisted pair cable with 22 AWG solid copper conductors.
8. Contact closure signal cable. Provide one (1) or more unshielded twisted pair cable with 22 AWG solid conductors. Quantity of pairs as required by the application.
9. HDMI Cables. All HDMI cables longer than 10 meters (32.8 ft.) must include an adaptive cable equalizer capable of providing not less than +40 dB of cable compensation @ 825 MHz. Such device must be capable of operating automatically without the need for human intervention and must include an external AC to DC power converter that can accept 100-240VAC @ 50/60 Hz. Furthermore, such device must also include I2C correction circuitry to mitigate the effects of long cable runs on the DDC clock and DDC data signals. HDMI cables shall have the following requirements:
 10. a. Support HDMI v1.3 with resolutions up to 1080P with 12-bit color depth
 - b. Support HDMI v1.3 Category 2 data rates (3.4 Gbit/sec.) lengths up to 7.5 meters
 - c. Support HDMI v1.3 data rates up to 2.25 Gbit/sec. lengths up to 40 meters
 - d. Support PC data rates up to 1.65 Gbit/sec. lengths up to 60 meters
 - e. Supports PC resolutions up to 1600x1200 / 60 Hz and 1920x1200 / 60 Hz
 - f. Made of AWG-22 gauge wires
 - g. Triple shield for noise immunity
 - h. Cable jacket shall have dual UL Ratings: UL13 (CL2) and UL758 (AWM20276) for non-plenum spaces. In plenum environments cables shall have a CL2P rating or CMP rating.
 - i. RoHS compliant.
 - j. Gold plated connectors

- k.
- 11. DVI Cables. All cables carrying DVI signals through conduit, floor slabs or longer than 10 ft. shall be HDMI cables as described in previous section with HDMI to DVI adapters in both ends.
- G. Connectors and plates: The AVS installer shall provide connector and plates to terminate all wiring part of the AVS, regardless if shown or not in the design drawings. As a general guideline the AVS Installer shall follow these recommendations:
- H.
 - 1. Only use crimp type BNC connectors on coaxial baseband video cables. Use crimp type F connectors on RF based coaxial cables. Use only connectors with the same impedance as the cable where they will be terminated.
 - 2. When custom panels or plates are required in the project, the AVS Installer shall submit detail drawings of all plates for approval by the Design Engineer.
 - 3. Whether shown in the design drawings or not all cables coming out of an outlet box into an equipment shall have a disconnect means at the outlet box with a face plate. Faceplates with grommets are not acceptable as pass-through connections to equipment.
 - 4. All termination of UTP Category (5e, 6 or 6A) cables shall be done in accordance to specification section 271000.

2.4 WORKSTATION FOR DIGITAL COURT RECORDING (DCR)

- A. General: The AVS Installer shall provide a dedicated workstation for DCR as indicated in the design drawings. The specifications of those workstations are:
 - 1. Intel processor I3 or greater.
 - 2. Latest offering of Microsoft Operating system for professional environments.
 - 3. Minimum of 8 GB of SDRAM
 - 4. Minimum of 1TB GB of SCSI hard drive 10,000 rpm.
 - 5. One DVD+/RW unit
 - 6. 512 MB video board with DVI-I output.
 - 7. Line level audio output.
 - 8. Keyboard and mouse: Provided
 - 9. Monitor: 19" monitor
 - 10. USB ports: no less than 3
- B. Acceptable manufacturers for the computer system are: Dell Optiplex 3020 or equivalent in the same Dell brand.

2.5 PROJECTOR TYPE 1

- A. General: The projector referenced in this specification section and in the design drawings as type 1 shall have the following specifications:
- B.
 - 1. Projector native image format: 16:10
 - 2. Projector technology: Laser Phosphor light
 - 3. Brightness: minimum 5200 ANSI Lumens

4. Native resolution: 1920 X 1200
 5. Contrast ratio: minimum 20,000:1
 6. Estimated lamp life: minimum 20,000 Hours.
 7. Lens: Manual zoom and focus
 8. Lens throw distance: as indicated in the drawings
 9. Usable resolutions: The unit shall be capable of displaying all resolutions, from 480i to 1080P in all HDMI inputs
 10. Video input ports: (1) HDMI HDCP compliant.
 11. Control ports: RS-232 in a DB9 connector.
 12. Warranty: 3 years, commercial grade unit
- C. Accessories: This projector shall be supplied with a corresponding lens to achieve the throw distance indicated in the design drawings. Projector mounts shall be provided with all projector. Design selection for the projector mount is Chief Manufacturing Company recommended mount for the projector specified.
- D. Accepted manufacturers:
1. Christie Digital,
 2. Panasonic,
 3. Sharp,
 4. Hitachi,
 5. NEC,
 6. Mitsubishi,
 7. Barco,
 8. Projection Design,
 9. Digital Projection,
 10. Epson,
 11. Optoma.

2.6 ELECTRIC SCREENS

- A. General: The Electric screen referenced in this specification section and in the design drawings shall have the following specifications:
1. Screen format: 16:10.
 2. Screen dimensions: As shown in the design drawings \pm 3 inchs
 3. Screen projection type: Front projection
 4. Screen case mounting: in-ceiling
 5. Tensioned screen: Yes
 6. Screen gain: 1
 7. Viewing angle: 45°
 8. Screen fabric: seamless, flame retardant, mildew resistant vinyl.
 9. Motor: oil free, quick reversal, with adjustable limit switches.
- B. Accepted manufacturers:
1. Da-Lite,
 2. Draper,
 3. Stewart.

2.7 NETWORKING EQUIPMENT

- A. General: All networking equipment required for the AVS shall be provided in the scope of work of the system.

2.8 IDENTIFICATION AND LABELING TAGS

- A. The AVS installer shall follow labeling materials indicated in specification section 270010.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

- A. General: The AVS installer shall follow all installation practices indicated in specification section 270010.
- B. Workmanship: The AVS Installer shall adhere to, at a minimum, the following installation practices:
- C.
 - 1. Securely mount equipment plumb and square in place. Where equipment is installed in cabinets, provide mounting bolts in all equipment rack fastening holes. All rack mount equipment shall be secured with Rackmount Solutions HTX™ security screws (STAR-TYPE or similar) provided with nylon washers between bolt heads and equipment.
 - 2. Where equipment (such as VHS players, monitors, DA's etc... and other system devices) is packaged by the manufacturer without rack mount ears or braces, as part of a regular manufacture process, the Installer shall provide all required, accessory ears, brackets, and shelves, which are necessary to properly mount the equipment within the designated cabinets and rack locations.
 - 3. Provide appropriate ventilation panels, vents, and/or fans to assure sufficient ventilation for adequate cooling of all equipment.
 - 4. Confirm the polarity and phasing of system components before installation. Connect to maintain uniform polarity and phasing.
 - 5. Insulate all non-insulated, stranded conductors before making termination when connecting to equipment terminals.
 - 6. "Wire", "wing" and "twist" NUT type connections are not permissible for any type of signal connection.
 - 7. All wiring is to be free from grounds loops, shorts, opens, and reversals.
 - 8. Neatly tie all cabling within equipment cabinets, housings, and terminal cabinets with nylon cable ties at not more than 12" intervals. Install in accordance with the latest EIA installation standards. Engineer approved wiring trough may be used in lieu of tie-wraps. Cable routing shall not braid or cross with other wires in parallel more than once.
 - 9. Secure all cables in equipment cabinets and terminal cabinets to provide strain relief at all raceway exits in accordance with NFPA 70 including all supplements. All plugs and receptacles are to be the grounding type.

10. Connect all equipment power to surge/noise suppression outlet strips or associated power conditioning devices.
 11. Where system cables are extended through an exposed umbilical connection, the Installer shall harness all associated cable within a common, manufactured, flexible, sheath (ex. Snakeskin™).
 12. All racks and cabinets shall be bonded to a grounding system as required by NEC.
- D. Raceways. All raceways for audio/visual devices shall have the following specifications:
- E.
1. Refer to specification section 270528 for all raceways specification.
 2. All cables for speaker level signals, regardless of their level shall be run in separate raceways from other low voltage cables.
 3. All cables for microphone level signals, regardless of their level shall be run in separate raceways from other low voltage cables.
 4. Raceways for AV outlets: Outlets for AV cables shall be composed of electrical boxes (sized for the amount of connectors) and a conduit(s) to the nearest accessible ceiling space. All AV outlet boxes shall be at least 2.5" deep.
 5. All indoor rated cables can be supported with j-hooks or cable hangers above accessible ceiling spaces. J-hooks shall be spaced no longer than 4. Ft.
- F. Labeling System. The labeling system for all cables shall be a system that allows for unique identifiers for each cable. Each cable has to have an indicator from where it is coming from and an indicator to where it is going to.
- G. Installation of Screens: Whether shown in the drawings or not the AVS installer shall install all projection screens following the following installation practices:
1. All electric screens shall be provided with a low voltage controller to be mounted inside the screen housing.
 2. All electric screens shall be provided with a control wall plate mounted at 48" A.F.F.
 3. All in-ceiling screens shall be leveled with the ceiling grid.
 4. All in-ceiling screens housing shall be plenum rated when installed in plenum spaces.
 5. All in-ceiling screens installed in hard ceilings shall include an access panel no smaller than 16"X16" to access the electrical junction box of the screen. Access panel shall be a metal panel, with a hinged door and painted the same color as the finished ceiling.
- H. Projector Installation: The Installer shall adhere to, at a minimum, the following installation practices for projectors:
1. Projector shall be provided with corresponding mounting brackets depending on the projector selected.
 2. All anchors and supports whether pre-fabricated or customs, required to mount the projector where indicated in the design drawings are in the scope of work of the AVS Installer
- I. Speaker Installation: The Installer shall adhere to, at a minimum, the following installation practices for speakers:

J.

1. All ceiling mounted speaker shall have a support wire tie to the building structure. Ceiling speakers shall not be supported from the ceiling grid.
2. All ceiling mounted speakers shall be installed with a backbox to prevent sound from dispersing into the plenum space and causing noise issues in adjacent rooms.
3. When ceiling speakers are mounted in fire rated partitions, the speakers shall have UL listed speaker back boxes with a fire rating no less than the rating of the partition.
4. All in-wall speakers shall be installed with pre-construction brackets.

K. Millwork Openings: When AV equipment like flip tops and plates will be mounted in millwork provided by the owner or third parties, the AVS installers shall provide cut out dimensions for all the AVS equipment listing location in the millwork where the cuttings need to be done. It is the AVS installer's responsibility to install those devices in the millwork, once the openings have been done. All millwork opening shall be done by the furniture manufacturer.

L. Floor Boxes. Floor boxes used for connection to teaching lecterns, podiums, conference tables, or mixing boards shall have at least the following minimum requirements:

M.

1. Floor boxes shall be large enough to have at least 3 different compartments, one for power one for voice/data cables and one for AV.
2. Each low voltage compartment shall have a separate raceway back to the accessible ceiling space. If speaker wires are run from the lectern, the AV compartment shall have one 1" and one 3/4" conduit to the nearest accessible ceiling space. If no speaker wires are run from the lectern, at least one 1" conduit from the AV compartment to the accessible ceiling shall be provided. Additional conduits might be required depending on the application.
3. There shall be no daisy-chaining of AV conduits between adjacent floor boxes. Floor boxes shall also allow to recess the connectors from the umbilical cord tied to the lectern.
4. Floor boxes shall have a recessed compartment to hold connectors. Floor boxes that leave AV connectors flushed with the floor are not desirable since they become tripping hazards and could be easy broken with the lectern when moved.
5. AV compartments shall have termination plates and connectors for all cables coming from the accessible ceiling space. Pass-through cables shall not be allowed in floor boxes. All connectors shall be properly secured to the plates in the floor box. All unused compartments shall have blank plates.

N. Structured Cabling Infrastructure: The AVS Installer shall adhere to specification section 271000 for all requirements of structured cabling components to be used as part of the AV system. The structured cabling components include but are not limited to:

O.

1. All unshielded twisted pair Category cables and fiber optic cables
2. Termination devices like termination jacks, patch panels and faceplates.
3. All UTP and fiber optics patch cords.
4. All testing procedures for Category and fiber optic cables.

3.2 REQUEST OF IP ADDRESS

- A. General: The AVS installer shall follow all requirements indicated in specification section 270010 for the request of IP addresses for devices part of the AVS.

3.3 SOFTWARE PROGRAMMING AND INSTALLER TESTING

- A. The owner will provide the AVS Installer the code used for the DSP processors in other courtrooms in the same courthouse, that have the same type of equipment as the AV equipment indicated in the design drawings and this specification. The AVS installer will be required to take that file and make any modifications required to make this system work and integrate into the overall recording system for the courtrooms.
- B. Data Wiring and Fiber Optic Testing: Testing of UTP data wiring, copper patch cords, fiber optic cables and fiber optic patch cords shall be done as indicated in specification section 271000. Testing results shall be submitted as indicated in the same specification section.
- C. Signal Adjustment: The AVS Installer shall ensure that the following adjustments, tests and measurements, at a minimum, have been completed:
- D.
 - 1. The system shall be measured and adjusted for optimum signal quality and minimum signal loss, to all audio and video signals, through the system channel, using appropriate test equipment and standardized testing procedures.
 - 2. The system shall be measured and adjusted for optimum signal-to-noise ratio and maximum headroom in the system electronics.
 - 3. The system shall be measured and adjusted to eliminate distortions or degradation of signal resulting from, but not limited to, clipping, hum, noise, and RFI interference.
 - 4. The Installer shall check the quality of each signal, at its source, and compare it against the quality of the signal at various points of its transmission through the system. The Installer shall correct the system for any significant (the lesser of 2dB or the manufacturers throughput requirements) signal distortion or loss.

3.4 SYSTEM WARRANTY AND SERVICE

- A. General: The AVS installer shall follow all warranty and service requirements indicated in specification section 270010.

3.5 ENGINEER'S FINAL ACCEPTANCE TEST

- A. General: The AVS installer shall follow all test requirements indicated in specification section 270010.
- B. As part of the Engineer's final acceptance all sources, inputs, outputs and interfaces will be tested. Additional notes about the final acceptance test:

C.

1. It is the sole responsibility of the AVS system installer to estimate the time allocated for this step. It is assumed that at this point in time all the features of the AVS system are clear to the Owner and the AVS Installer so this step is just to make sure that all the features are working properly as agreed.
2. The AVS installer shall have different AV media and input signal generators to test all input plates and sources in the AVS system.
3. The quantity of staff required to attend these meetings by the AVS Installer is sole decision of the AVS Installer.
4. Failure to complete one or more of the previously issued punch list items or failure to correct any programming changes previously noted will revoke acceptance of the room or system being tested.
5. Final acceptance will be granted on a room by room basis.

3.6 TRAINING AND INSTRUCTION

- A. General: The AVS installer shall follow all training requirements indicated in specification section 270010. The AVS Installer shall provide the owner with different types of training as described herein.
- B. System Administration Training. The AVS installer shall provide system administration training at the job site as described below:

C.

1. At least 8 hours of training shall be provided.
2. Travel time will not be counted as part of the training sessions.
3. Training will be broken down to a maximum of 2 sessions in different days.
4. The objective of the system administration training will be to properly operate, trouble shoot, calibration and perform specific field repairs to AVS equipment.
5. Field repair and calibration training will be limited to those repairs noted by the manufacturer of the equipment as field repairs done by non factory trained personnel.
6. Training shall be done at the job site with all the equipment operational after final acceptance.
7. Training will be limited to a maximum of 5 attendees per session.
8. Operation and Maintenance manuals shall be delivered at the beginning of this sessions.

3.7 AS BUILT DOCUMENTS AND CLOSE OUT INFORMATION

- A. General: The AVS installer shall follow all as built and close out information requirements indicated in specification section 270010
- B. The following information shall be included in the as built drawings:

C.

1. Drawings indicating final floor plan locations of all AV devices
2. One line diagrams with all devices connected in the system.
3. Mounting details

4. Any signed and sealed structural calculations required for the AVS
- D. Additional close out information to be delivered by the AVS installer:
- E.
1. All programming source code done by the AVS for this project for all pieces of equipment in digital format (no printed copies required).
 2. List of all IP addresses assigned to each equipment part of the AVS.
 3. Compiled executable files as requested for Computer based user interface.
 4. All printed test results.

END OF SECTION 274100

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SECTION 313116

TERMITE CONTROL

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. Soil treatment (At Slab Repairs).
 - 2. Bait-station system only required at wood frame buildings
 - 3. Metal mesh barrier system only required at wood framed buildings.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
 - 2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of termite control product.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
 2. Moisture content of soil before application.
 3. Termiticide brand name and manufacturer.
 4. Quantity of undiluted termiticide used.
 5. Dilutions, methods, volumes used, and rates of application.
 6. Areas of application.
 7. Water source for application.
- D. Bait-Station System Installation Report: After installation of bait-station system is completed, submit report for Owner's records and include the following:
1. Location of areas and sites conducive to termite feeding and activity.
 2. Plan drawing showing number and locations of bait stations.
 3. Dated report for each monitoring and inspection occurrence, indicating level of termite activity, procedure, and treatment applied before time of Substantial Completion.
 4. Termiticide brand name and manufacturer.
 5. Quantities of termiticide and nontoxic termite bait used.
 6. Schedule of inspections for one year from date of Substantial Completion.
- E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products and who is accredited by manufacturer.

1.7 FIELD CONDITIONS

- A. Soil Treatment:
1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
 2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Three years from date of Substantial Completion.
- B. Wood Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied wood termiticide treatment will prevent infestation of subterranean termites. If subterranean termite damage is discovered during warranty period, repair or replace damage caused by termite infestation and treat replacement wood.
 1. Warranty Period: 12 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain termite control products from single source.

2.2 SOIL TREATMENT

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
 1. BASF Corporation, Agricultural Products; Termidor
 2. Bayer Environmental Science; Premise 75
 3. FMC Corporation, Agricultural Products Group; Dragnet FT
 4. Syngenta; Demon TC
 5. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

2.3 BAIT-STATION SYSTEM

- A. Description: EPA-Registered system acceptable to authorities having jurisdiction. Provide bait stations based on the dimensions of building perimeter indicated on Drawings, according to product's EPA-Registered Label and manufacturer's written instructions.
 1. fBASF Corporation, Agricultural Products; Subterfuge.
 2. Dow AgroSciences LLC; Sentricon System.
 3. Ensystem, Inc.; Exterra System.
 4. FMC Corporation, Agricultural Products Group; First Line.
 5. Whitmire Micro-Gen Research Laboratories, Inc.; Advance TBS.

2.4 METAL MESH BARRIER SYSTEM

- A. Stainless-Steel Mesh: 0.025-by-0.018-inch (0.64-by-0.45-mm) mesh of 0.08-inch- (2.0-mm-) diameter, stainless-steel wire, Type 316.

1. Termimesh USA, Inc

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
 1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.

3. Masonry: Treat voids.
 4. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 INSTALLING BAIT-STATION SYSTEM

- A. Bait-Station System: Install after construction, including landscaping, is completed.
- B. Place bait stations according to product's EPA-Registered Label and manufacturer's written instructions, in the following locations:
1. Conducive sites and locations indicated on Drawings.
 2. In and around infested trees and stumps.
 3. In mulch beds.
 4. Where wood directly contacts soil.
 5. Areas of high soil moisture.
 6. Near irrigation sprinkler heads.
 7. Each area where roof drainage system, including downspouts and scuppers, drains to soil.
 8. Along driplines of roof overhangs without gutters.
 9. Where condensate lines from mechanical equipment drip or drain to soil.
 10. At plumbing penetrations through ground-supported slabs.
 11. Other sites and locations as determined by licensed Installer.
- C. Spacing: Place bait stations according to manufacturer's written instructions and at a frequency no less than the following:
1. One bait station per 10 linear feet (3.1 linear meters)

3.5 INSTALLING METAL MESH BARRIER SYSTEM

- A. Install metal mesh barrier system to provide a continuous barrier to entry of subterranean termites, according to manufacturer's written instructions.
1. Fit mesh tightly around pipes and other penetrations and terminate at slab and foundation perimeters.
 2. Install mesh under the perimeter of concrete slab edges and joints after vapor retarder and reinforcing steel are in place.

3.6 PROTECTION

- A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

- B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.7 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include quarterly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
 - 1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 313116